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THUMBING DOESN'T ALWAYS MAKE THE GENUS: REVISION OF *MICROJASSA* STEBBING (CRUSTACEA: AMPHIPODA: ISCHYROCERIDAE)

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ABSTRACT

Thumb production is a male secondary sexual character of the propodus of the second gnathopods in many species of ischyrocerid amphipods. Historically, it has been considered to be a synapomorphy for the ischyrocerid genera *Jassa* Leach and *Microjassa* Stebbing. This is indeed the case for *Jassa,* but thumb production differs fundamentally in *Microjassa* and is not a synapomorphy for the genus. Instead the species of *Microjassa* are bound by characters of the antennae and coxae. The genus is revised to comprise the type species *M. cumbrensis* Stebbing and Robertson, *M. litotes* J. L. Barnard, *M. macrocoxa* Shoemaker, and the new species *M. floridensis, M. tetradonta, M. bahamensis, M. bousfieldi, M. barnardi,* and *M. boreopacifica. Microjassa claustris* J. L. Barnard and *M. chinipa* J. L. Barnard are transferred to a new genus, *Neoischyrocerus,* along with *Jassa lilipuna* J. L. Barnard. *Jassa socia* Myers is transferred to the genus *Ischyrocerus* Krøyer. A consequence of this revision is that most prior species identifications for the genus *Microjassa* cannot be considered valid, particularly where species overlap in range. Most species in the genus are difficult to recognize when large males are lacking. Wherever possible characters that are not subject to sexual selection are given in the keys and descriptions to aid species identification.

The genus *Microjassa* was established by Stebbing (1899) for the British species *Podocerus cumbrensis* Stebbing and Robertson (1891). The name was coined to describe the small body size (maximum 4 mm length) and thumbed appearance of the propodus of the male gnathopod 2 which resembled that of species of *Jassa.* Other diagnostic characters were the greater depth of coxae 2–4 relative to 1 and 5, coxa 4 posteriorly excavate, antenna 2 little stronger than antenna 1, maxilliped outer plates scantily spined, and gnathopod 2 (female) little differing in form from gnathopod 1 (as in *Ischyrocerus* Krøyer, 1838 but not in *Jassa*).

Subsequently four species were added to the genus: *M. macrocoxa* Shoemaker, 1942, *M. litotes* J. L. Barnard, 1954, *M. claustris* J. L. Barnard, 1969a, and *M. chinipa* J. L. Barnard, 1979. All were of similar size, but only in *M. macrocoxa* did the male produce a thumb as it matured. J. L. Barnard (1954) justified the inclusion of *M. litotes* on the basis of resemblance of juveniles to juveniles of *M. cumbrensis.* In order to accommodate *M. claustris,* J. L. Barnard (1969b, 1973) added to the genus diagnosis characters of the antenna 1 accessory flagellum, gnathopod 1, and uropod 3, and modified the statement on the relative depth of coxae 4:5. J. L. Barnard (1969a) recognized that *M. claustris* differed in many respects from other members of *Microjassa,* but he justified its inclusion by its small size and greater similarity to this genus than to other genera of the Ischyroceridae. J. L. Barnard (1979) justified the addition of *M. chinipa* to the genus on the basis of its close similarity to *M. claustris.* Unfortunately, J. L. Barnard (1969a, 1973) overlooked the fact that the antenna 1 accessory flagellum, coxa 4, and uropod 3 characters did not hold for either of these species.

Krapp-Schickel and Schiecke (1974) uncritically reiterated J. L. Barnard's (1973) diagnosis of *Microjassa.* Lincoln (1979) accepted only two species in the genus (*M. cumbrensis* and one other, unspecified), recognizing the antenna 1 and coxal characters but using Stebbing's stricter definition of coxa 4:5 depth. How-

ever, he also included a number of characters of the mouthparts, uropod 3, telson, and body shape which were not diagnostic of the genus.

Conlan (1988, 1989) recognized, on the basis of multivariate and cladistic analyses, that the genus *Microjassa* should comprise *M. cumbrensis, M. litotes,* and *M. macrocoxa. Microjassa claustris* and *M. chinipa* should be transferred to a new genus that would hold also *Jassa lilipuna* J. L. Barnard, 1970. J. L. Barnard and G. S. Karaman (1991) responded by moving *M. claustris* and *M. chinipa* to *Ischyrocerus* but retained *J. lilipuna* in the genus *Jassa.* They also removed *M. litotes,* transferring it to the genus *Ischyrocerus* because the male did not produce a thumb, despite the similarity in coxal size relationships and excavation of coxa 4, characters that seemed unique to the genus *Microjassa.*

Recent discovery of new species from the Atlantic and Pacific coasts of North America which conformed in coxal pattern with that of species of the genus defined by Conlan (1988, 1989), but whose males did not all produce a thumb at maturity, indicated that, unlike the genus *Jassa,* thumb production was not a synapomorphy for the genus *Microjassa.* Instead, the species of the genus were bound by characters of the antennae and coxae. The genus *Microjassa* is revised accordingly in this paper. *Microjassa litotes* is returned to its proper genus and the new species are added. *Jassa socia* is transferred to the genus *Ischyrocerus* and *Jassa lilipuna* is transferred to a new genus, *Neoischyrocerus,* which will accommodate *M. claustris* and *M. chinipa* as well.

Methods

Material was provided by the following museums (acronyms and curators in parentheses): Allan Hancock Foundation, University of Southern California (AHF, J. L. Haig) (collection now housed at the Natural History Museum of Los Angeles County (NHMLAC, H. G. Kuck)); Bernice P. Bishop Museum (BPBM, R. H. Titgen); British Columbia Provincial Museum (BCPM, P. Lambert); British Museum (Natural History) (BM(NH), J. Ellis); Muséum National d'Histoire Naturelle (MNHN, J. Forest); Canadian Museum of Nature (formerly National Museum of Natural Sciences) (CMN, E. L. Bousfield); United States National Museum (USNM, J. L. Barnard).

Specimens were identified by reference to type specimens using characters that had been found invariant with age and sex for other genera of the Corophioidea (Conlan, 1983, 1988, 1989, 1990; Conlan and Bousfield, 1982a, 1982b). Specimens were illustrated by camera lucida from the whole body stained with methylene blue, and from dissected appendages mounted in polyvinyl lactophenol stained with lignin pink. Body length was measured by eyepiece micrometer from the tip of the rostrum to the base of the telson. Ratios given in the descriptions are of maximum width (W) or maximum length (L) of one article or part of an article relative to another.

Revision of the Genus *Microjassa*

Microjassa Stebbing

Microjassa Stebbing, 1899, 240; 1906, 651. Chevreux and Fage, 1925, 350. J. L. Barnard, 1969a, 160; 1969b, 279; 1973, 26. Krapp-Schickel and Schiecke, 1974, 404. Lincoln, 1979, 564.

Type Species.—Podocerus cumbrensis Stebbing and Robertson, 1891. By monotypy.

Diagnosis.—Antenna 1, accessory flagellum 1 article. Coxa 1 and especially coxa 5 half or less the depth of coxae 2–4; coxa 4 posteriorly excavate. Gnathopods 1 and 2 and pereiopods 5–7, face of dactyl not serrated. Adult male with stridulating nodules or ridges on basis of gnathopod 2 and associated ridges on medial face of coxae 2 or 3.

Description.—Length up to 4.0 mm. Antenna 1, accessory flagellum 1 article. Upper lip, ventral margin shallowly indented. Mandibular palp, article 3 narrower than long. Pereiopods 2–4, coxa depth at least 1.5 times depth of body. Gnathopod 1, depth of coxa less than 0.6 depth of coxa 2. Pereiopod 4, coxa posteriorly

excavate. Pereiopod 5, coxa depth less than 0.6 depth of coxa 4. Gills broad (width 0.5 length). Gnathopods 1 and 2 and pereiopods 5–7, face of dactyl without serrations (although anterior margin may be faintly cusped). Gnathopod 1, male, basis length 0.48–0.63 that of gnathopod 2 basis. Gnathopod 1, female, propodus more slender than and slightly smaller than propodus of gnathopod 2. Gnathopod 2, female, palm of propodus slightly excavate near junction of dactyl; brood plates wide, sides broadly convex, setae not hook-tipped. Gnathopod 2, male, basis usually inserted on central or proximal part of coxa, with stridulation ridges or minute nodules, anterior marginal setae restricted to distal portion of basis or absent altogether; dactyl with 0 or 1 protuberances, inner margin usually not cusped. Pereiopods 3 and 4, propodus, posterior margin not spinose. Telson with small spines, setae, and/or cusps at each apex.

Distribution.—Cold temperate to tropical, occurring on the Pacific coast of North America from southeastern Alaska to Baja California, on the Atlantic coast of North America in the Gulf of Mexico, the Caribbean Sea, and the Atlantic coast of Florida and South Carolina, and on the Atlantic coast of the United Kingdom, on the Mediterranean coast of France and Italy, and in the Bosporus Strait.

Remarks.—Component species are, *M. cumbrensis* (type species), *M. litotes, M. macrocoxa, M. bahamensis, M. tetradonta, M. floridensis, M. bousfieldi, M. barnardi,* and *M. boreopacifica.* Of all genera in the Ischyroceridae, *Microjassa* is cladistically most close to *Neoischyrocerus* n.g. (Conlan, 1988).

Like most corophioidean amphipods, species of *Microjassa* are sexually dimorphic. The appendages of early instars are sexually indistinguishable. Males can be recognized by small peniai papillae on the seventh sternite. Development of secondary sex characters is gradual and instar stage cannot be determined from body morphology. With increasing body size the second gnathopod of the male becomes progressively larger, stridulation ridges appear, and, depending upon the species, a thumb-like projection develops on the propodus at the location of the palmar defining spine. Small teeth may also appear in the palm between thumb and dactyl. Large (and presumably adult) males also differ from unsexable juveniles and adult females by developing a more pediform, less setose second antenna, although the extent of change is never as great as in the second gnathopod and varies with the species. The first gnathopod of large males may be spinier than in juveniles in some species also.

KEY TO THE WORLD SPECIES OF *MICROJASSA*

1a. Gnathopod 2 larger than and different in appearance from gnathopod 1 (Figs. 1–9) (increasingly so with size). Pereiopods 2–5 without brood plates. Sternite 7 with pair of penial papillae ..... Male 2

1b. Gnathopod 2 hardly larger than gnathopod 1 (Figs. 1–9). Adult female, pereiopods 2–5 with brood plates which interleave to form the egg carrying marsupium (smaller and non-setose in subadult, absent in juvenile). Sternite 7 without pair of penial papillae ..... Female and Unsexable Juvenile[1] 10

MALE

2a. Uropod 1 without spinous process extending under rami from ventral surface of peduncle (Fig. 1) 3

2b. Uropod 1 with spinous process extending under rami from ventral surface of peduncle (Figs. 5–9) 5

[1] This category includes also individuals that have a somewhat enlarged second gnathopod, indicating that they are males, but which are clearly not large enough to bear the secondary sexual characters referred to in the key to males.

3a. Antenna 2 hardly larger than and barely less setose than antenna 1. Gnathopod 2, propodus, palmar thumb originating on proximal half of propodus, not reaching level of dactyl insertion; anterodistal setal group at dactyl origin ½ or more length of dactyl. Atlantic Ocean: Gulf of Mexico and Atlantic coast of Florida and South Carolina ..... *M. floridensis* n. sp. (Fig. 1)

3b. Antenna 2 about ⅓ larger than and much less setose than antenna 1. Gnathopod 2, propodus, palmar thumb originating on distal half of propodus, extending to same level as dactyl insertion; anterodistal setal group at dactyl origin less than ½ length of dactyl (Figs. 2, 3) 4

4a. Gnathopod 2, basis, lateral flange abruptly narrowed at junction of coxa, margin with minute ridges or cusps for stridulation; propodus, palm with one tooth centrally in addition to teeth at dactyl hinge and thumb at posterior of palm. Pereiopod 3, coxa, medial surface with diagonal row of stridulation ridges. Pacific Ocean: Baja California ..... *M. macrocoxa* Shoemaker (Fig. 2)

4b. Gnathopod 2, basis, lateral flange evenly tapered to junction of coxa, bearing minute nodules but no stridulation ridges; propodus, palm with two central palmar teeth in addition to hinge teeth and thumb. Pereiopod 3, coxa, medial surface finely crenulated but without row of stridulation ridges. Atlantic Ocean: Gulf of Mexico ..... *M. tetradonta* n. sp. (Fig. 3)

5a. Gnathopod 2, coxa with medial stridulation ridges; carpus ⅓–½ length of propodus; propodus, posterior margin straight, lacking tooth or change of angle to mark palm; defining spine large, about ½ setal length, midway between carpus and dactyl. Pereiopods 3 and 4, carpus less than ¼ overlapped by merus. Atlantic Ocean: Andros Island (Bahama Islands) ..... *M. bahamensis* n. sp. (Fig. 4)

5b. Gnathopod 2, coxa without stridulation ridges; carpus ¼ or less length of propodus; propodus with thumb or change of angle to mark palm; defining spine minute, at tip of thumb or absent. Pereiopods 3 and 4, carpus ⅓–½ overlapped by merus (Figs. 5–9) 6

6a. Gnathopod 1, basis anterodistally spinose. Uropod 3, outer ramus terminating in 4–7 cusps and basally immersed, dorsally recurved spine. Pacific Ocean: southeastern Alaska and British Columbia ..... *M. boreopacifica* n. sp. (Fig. 5)

6b. Ganthopod 1, basis not anterodistally spinose. Uropod 3, outer ramus terminating in 7–14 cusps, without basally immersed, dorsally recurved spine (although fine lateral setae may be present) (Figs. 6–9) 7

7a. Gnathopod 2, propodus, palm with two to three teeth near dactyl hinge and long thumb posteriorly (length varying with age). Atlantic Ocean: U.K., Europe ..... *M. cumbrensis* (Stebbing and Robertson) (Fig. 6)

7b. Gnathopod 2, propodus, palm with small tooth at dactyl hinge but without thumb (palm defined by change of angle only) (Figs. 7–9). Pacific Ocean: southeastern Alaska to California 8

8a. Gnathopod 2, basis, insertion into coxa proximal to centre; basis anterodistally spinose or setose; propodus, anterior margin minutely setose, bearing rounded protuberance (large male); palm convex (large male) or concave (small male); dactyl, posterior (inner) margin bearing minute setae only ..... *M. litotes* J. L. Barnard (Fig. 7)

8b. Gnathopod 2, insertion into coxa at centre or distal to centre; basis without spines, but may be minutely setose; propodus, anterior margin bare or with long spine-like setae, but without proturberance; palm concave; dactyl, posterior (inner) margin bearing few to many long plumose or simple setae (large males more so than small males), anterior (outer) margin with row of minute setae (Figs. 8, 9) 9

9a. Gnathopod 1, palm straight or shallowly concave. Gnathopod 2, propodus, anterior margin bearing row of spine-like setae ..... *M. barnardi* n. sp. (Fig. 8)

9b. Gnathopod 1, palm convex. Gnathopod 2, propodus, anterior margin without row of spine-like setae ..... *M. bousfieldi* n. sp. (Fig. 9)

Female[2] and Unsexable Juvenile

10a. Uropod 1 without ventral peduncular spinous process (Fig. 1) 11

10b. Uropod 1 with ventral peduncular spinous process (Figs. 5–9) 12

11a. Atlantic Ocean: Gulf of Mexico ..... *M. tetradonta* n. sp. (Fig. 2)

11b. Pacific Ocean: Baja California ..... *M. macrocoxa* Shoemaker (Fig. 3)

12a. Pereiopods 3 and 4, carpus less than ¼ overlapped by merus. Atlantic Ocean: Andros Island (Bahama Islands) ..... *M. bahamensis* n. sp. (Fig. 4)

[2] The female of *M. floridensis* is unknown.

12b. Pereiopods 3 and 4, carpus ⅓–½ overlapped by merus. Northeastern Pacific or northeastern Atlantic 13
13a. Uropod 3, outer ramus terminating in 4–7 cusps and basally immersed, dorsally recurved spine. Pacific Ocean: southeastern Alaska and British Columbia ..... *M. boreopacifica* n. sp. (Fig. 5)
13b. Uropod 3, outer ramus terminating in 7–14 cusps, without basally immersed, dorsally recurved spine (Figs. 6–9) 14
14a. Gnathopod 2, propodus, palm slightly sinuous or evenly convex, not marked by abrupt change of angle at position of defining spines (Figs. 6, 9) 15
14b. Gnathopod 2, propodus, palm marked by abrupt change of angle at position of defining spines (Figs. 7, 8) 16
15a. Gnathopod 2, propodus, width about 60% of length. Atlantic Ocean: U.K., Europe ..... *M. cumbrensis* (Stebbing and Robertson) (Fig. 6)
15b. Gnathopod 2, propodus, width about 55% of length. Pacific Ocean: California ..... *M. bousfieldi* n. sp. (Fig. 9)
16a. Gnathopod 2, coxa, anterior margin convex with respect to posterior margin ..... *M. litotes* J. L. Barnard (Fig. 7)
16b. Gnathopod 2, coxa, anterior and posterior margins parallel ..... *M. barnardi* n. sp. (Fig. 8)

Microjassa floridensis new species
Figure 1

Diagnosis.—Uropod 1 without spinous process extending under rami from ventral surface of peduncle. Uropod 3, outer ramus with 3–4 terminal cusps. Pereiopods 3 and 4, carpus 40–50% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male, gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face, presumably for stridulation; propodus with long thumb originating proximally, thumb not reaching level of dactyl insertion, setal group at dactyl origin ½ or more length of dactyl, defining spine minute, anterior margin without spine-like setae. Female unknown.

Description.—ADULT MALE. Holotype: Length 1.6 mm. Antennae absent. Mandibular palp not dissected and therefore not visible. Pereiopods 1–4, basis, posteromedial margin with up to 2 setae. Gnathopod 1, coxa: coxa 2, L = 0.41; basis not anteriorly spinose; carpus, anterodistal margin without seta, posterior lobe: anterior margin, L = 0.42; propodus, palm not defined by abrupt change in angle; dactyl with 2 cusps. Gnathopod 2, coxa without stridulation ridges, ventral and posterior margin straight; basis inserted at midpoint of coxa, basis not spinose, but with minute nodules between lateral and medial flanges, lateral flange evenly tapering to coxal junction, without stridulation ridges; carpus : propodus, L = 0.09; carpus, anterodistal margin and posterior lobe without setae; propodus, anterior margin convex, without setose protrusion or row of spines, setae at dactyl hinge long, more than half length of dactyl, palm straight and lightly setose, hinge teeth opposite, with 1 shallow central tooth, thumb : propodus, L:W = 0.78, thumb originating proximally, posterior margin straight, anterior margin convex, with minute spine at tip; dactyl : propodus, L = 0.50, not posteriorly crenulate, without protuberance, inner marginal setae : dactyl, L:W = 0.08, outer margin without row of short setae. Pereiopod 3, coxa : coxa 4, L = 1.01, coxa 3, medial face finely crenulated, carpus 0.50 overlapped by merus. Pereiopod 5, coxa : coxa 4, L = 0.41. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 2 distal spines but without medial spines and without posteroventral spinous process. Uropod 3, peduncle with 1 distal spine but no medial spines, outer ramus terminating in 4 cusps (left) and 3 cusps (right), but without spines or setae. Telson with pair of erect setae but without spines or cusps.

CONDITION. Without antennae 1 and 2, pereiopods 3–7.

VARIATION. Male, 1.7 mm: Gnathopod 2, coxa longer, more rectangular than in

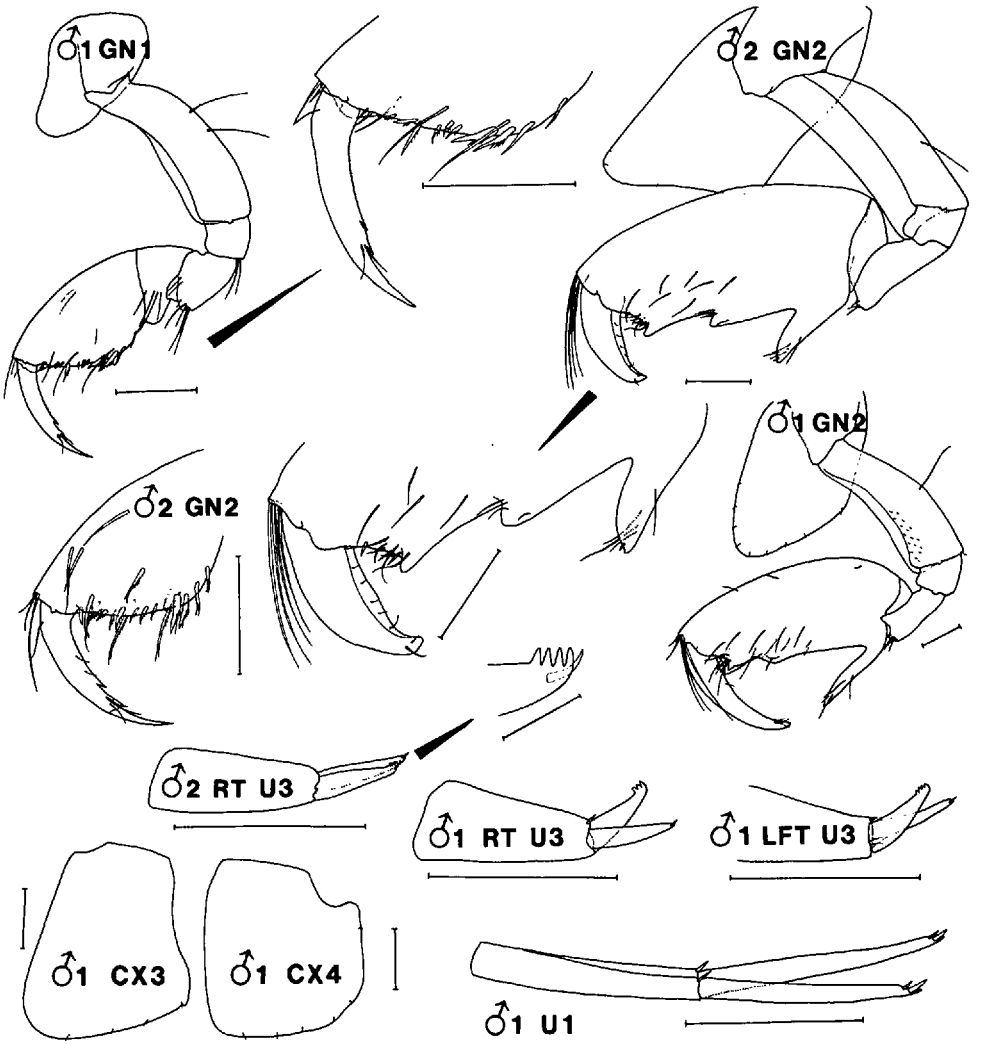


Figure 1. *Microjassa floridensis* n. sp. Male 1, holotype, 1.6 mm, station P243; male 2, 1.7 mm, station P414; Gulf of Mexico, 18 km off Panama City, Florida, 9 January 1965. Lateral views: coxae, uropods 1 and 2, and right uropod 3; other views medial. Scale 0.1 mm. Designations for this and subsequent illustrations: A, antenna; CX, coxa; DACT, dactyl; GN, gnathopod; JUV, juvenile; LL, lower lip; LFT, left; MD, mandible; MX, maxilla; MXPD, maxilliped; P, pereiopod; RT, right; STRID. RIDGES, stridulating ridges; T, telson; UL, upper lip; U, uropod.

holotype; basis, lateral flange wider, without minute nodules; carpus, anterior margin longer; propodus, hinge tooth not bifid, central palmar tooth deeper, thumb shorter and stouter, more distal from carpus; dactyl stouter and shorter. Uropod 3, outer ramus with slender, basally immersed, dorsally recurved spine.

FEMALE. Unknown.

Type Material.—Holotype, adult male, Gulf of Mexico, 30°00.6'N, 85°54.2'W, 18 km off Panama City, Florida, 9 January 1965, amongst fouling community on a float submerged at 29 m depth (1 m above the seabottom) (CMN: catalogue no. NMCC1986-153, station P243, F-1). Paratype, 1 adult male, same location, 7 August 1965 (CMN: catalogue no. NMCC1989-0810, station P414, F-1U).

Other Material Examined.—None.

Remarks.—*Microjassa floridensis* approximates *M. cumbrensis* in the form of the male's second gnathopod. However, it can be distinguished by the long setae at the anterior junction of the propodus and dactyl. The hinge teeth are bifid, rather than sequential, and are less pronounced. The dactyl lacks the long setae and distal cluster found in *M. cumbrensis*. Features of the uropods also differ: *M. floridensis* lacks medial spines on the uropod 1 peduncle and a ventral spinous process, and bears fewer cusps on the uropod 3 outer ramus. The differences exhibited by the 1.7 mm male *M. floridensis* may be indicative of a separate species; however additional specimens are required for a conclusive decision. The holotype may, indeed, bear a recurved spine on the uropod 3 outer ramus but definitive conclusions would require examination by electron microscopy.

Culpepper (1969) also examined *M. floridensis* but did not formally describe it. The features of a 3.5 mm male that differ from or were unknown for the holotype are exerpted as follows: eye reddish to light brown. Antenna 1 approximately as long as the head and segments 1–5 combined and distinctly longer than that of *M. litotes, M. macrocoxa,* or *M. cumbrensis*; flagellum 2 articles. Uropod 1, peduncle with 1 medial and 2 distal spines. Uropod 3, outer ramus with 5 cusps, occasionally 6 in other specimens. Telson with 4 spines in a lateral row at widest part (varying slightly in number and position on other specimens). Females gravid at 1.5–2.0 mm, indistinguishable from juvenile females of *M. tetradonta.*

Pequegnat and Pequegnat (1968) collected *M. floridensis* in very small numbers at the type locality in January, June, July and August of 1965 and only from floats submerged at 29 m depth (other collecting depths at this location were 4 m, 10 m, and 17 m). Annual temperature at this depth ranged from 13 to 29°C. Although two other fouling stations were established at 3 and 40 km offshore of Panama City, Florida, *M. floridensis* was not found. *Microjassa floridensis* is not known from any other locality.

Etymology.—In reference to the type location.

Distribution.—Gulf of Mexico, off Florida, on float submerged at 29 m depth (1 m above the seabottom), high salinity exposed coast.

Microjassa macrocoxa Shoemaker
Figure 2

Microjassa macrocoxa Shoemaker, 1942, 44. J. L. Barnard, 1962, 111; 1979, 128; J. L. Barnard and G. S. Karaman, 1991, 214.

Diagnosis.—Uropod 1 without ventral spinous peduncular process. Uropod 3, outer ramus with 2–5 terminal cusps. Pereiopods 3 and 4, carpus 40–50% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male, gnathopod 2, basis with cusps along anterior margin for stridulation against ridges on medial face of coxa 3; propodus, palm with one tooth centrally in addition to hinge tooth and thumb, thumb originating distally, defining spine minute, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm slightly excavate, marked by abrupt change in angle at position of defining spines.

Description.—ADULT MALE. (Redescription of holotype.) Length 3.4 mm. Antenna 1 absent (paratype, male, 3.8 mm, antenna 2 twice length of antenna 1; antenna 2, peduncle setae shorter than peduncle width; flagellum 2 articles). Mandibular palp, article 3, W:L = 0.44. Pereiopods 1–4, basis, posteromedial margin with up

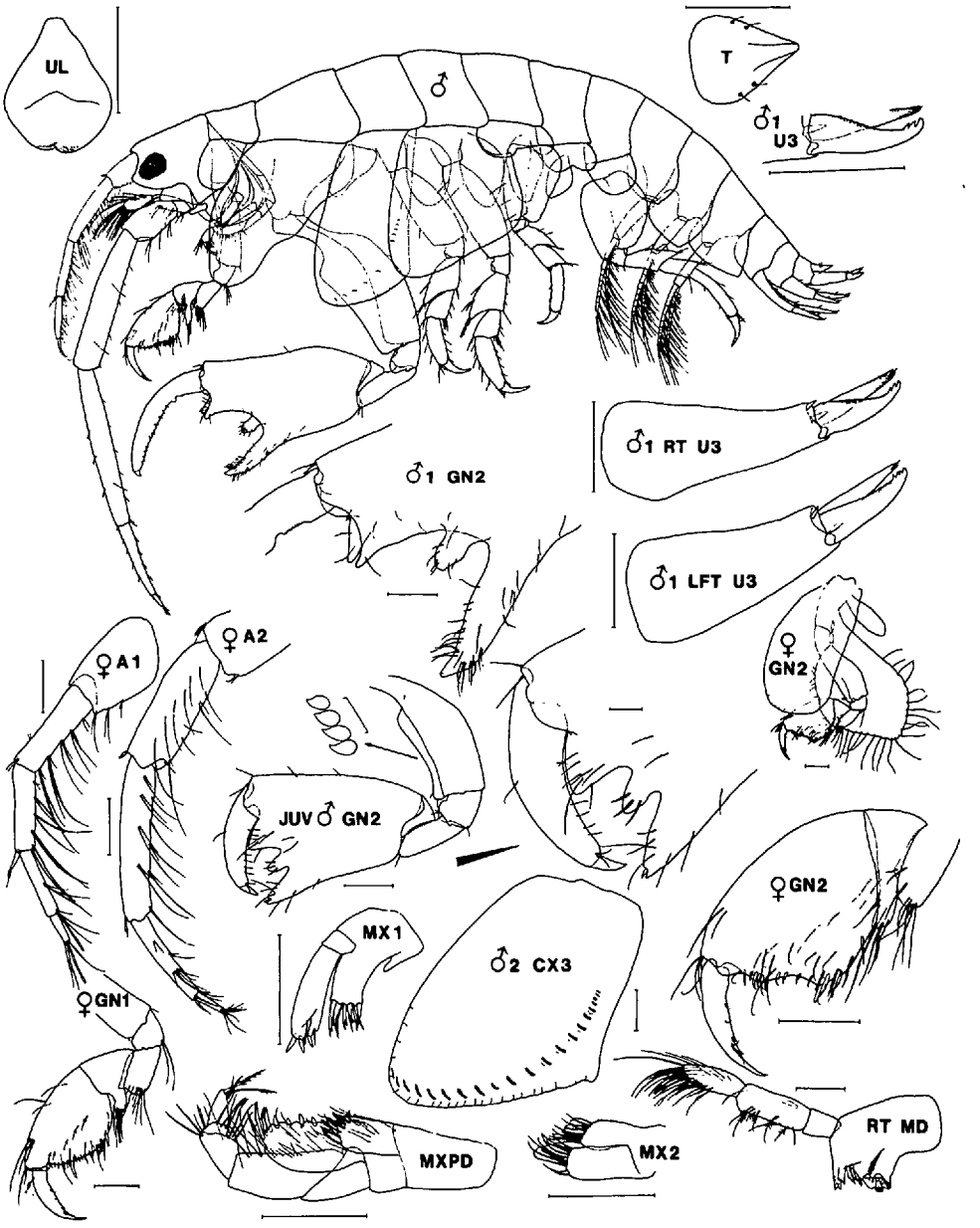


Figure 2. *Microjassa macrocoxa* Shoemaker. Male, holotype, 3.4 mm; male 1, 3.8 mm; adult female, paratype, 3.3 mm; Bahía Magdalena, Baja California, 18 July 1938. Juvenile male, 2.3 mm, Topolobampo, Mexico, collection date unknown. Note growth stages in the male second gnathopod, stridulation ridges, and variation in the number of cusps on the third uropod outer ramus. Lateral views: whole body, upper lip, maxillae 1 and 2, uropod 3 of male 1, antenna 1, and female gnathopod 2; dorsal view: telson; other views medial. Right mandible of the holotype; other mouthparts of the male 2; antenna 1 from Shoemaker (1942). Scale 0.1 mm.

to 4 setae. Gnathopod 1, coxa:coxa 2, L = 0.26; basis, anterior margin not spinose; carpus, anterodistal margin without seta, posterior lobe:anterior margin, L = 0.21; propodus, palm defined by change in angle; dactyl with 5 cusps. Gnathopod 2, coxa without stridulation ridges, ventral margin narrowed, posterior margin sinuous; basis inserted dorsal to mid-point of coxa 2, basis not spinose, anterolateral flange abruptly narrowed dorsally, margin finely cusped for stridulation; carpus:propodus, L = 0.12, anterodistal margin and posterior lobe without setal groups; propodus, anterior margin sinuous, without setose protuberance and row of spines, setae at dactyl hinge short, less than half length of dactyl, palm strongly excavate and weakly setose, hinge tooth bifid to accommodate dactyl, with additional short medial tooth between hinge tooth and thumb, thumb:propodus, L:W = 0.71, thumb originating distally, straight, but directed about 45° from posterior margin of propodus, tip with small spine; dactyl:propodus, L = 0.67, posterior margin proximally crenulate, with 1 small protuberance, inner marginal setae:dactyl, L:W = 0.15, outer margin without row of short setae. Pereiopod 3, coxa:coxa 4, L = 1.29, coxa 3, medial face with curved row of stridulation ridges; carpus 0.55 overlapped by merus. Pereiopod 5, coxa:coxa 4, L = 0.24. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 4 spines, without posteroventral spinous process. Uropod 3, peduncle with 1 distal spine but no medial spines; outer ramus terminating in 3 cusps, but without terminal setae or recurved spine. Telson with pair of erect setae, but without spines or cusps.

CONDITION. Without antenna 1, left pereiopods 5–7 or right pereiopod 6, merus to dactyl.

ADULT FEMALE. (Redescription of paratype.) Length 3.3 mm. Antenna 1:antenna 2, L = 0.81; antenna 2, peduncle setae longer than peduncle width. Gnathopod 1, coxa:coxa 2, L = 0.37. Gnathopod 2, coxa, ventral margin broadly convex, posterior margin straight; without nodules or stridulation ridges; basis, lateral flange not abruptly narrowed dorsally; carpus:propodus, L = 0.34; propodus and dactyl similar in shape to and only slightly larger than propodus of gnathopod 1, palm slightly excavate, marked by abrupt change in angle at position of defining spines. Pereiopod 3, coxa:coxa 4, L = 1.00, W = 0.75. Uropod 3, outer ramus terminating in 4 cusps. Other character states as in male.

CONDITION. Ovigerous, without right or left pereiopods 5–7.

VARIATION. Length: male up to 3.8 mm, female up to 3.3 mm. Young males differ from later instars in the appearance of the second antennae and second gnathopod. In juvenile males the antenna 2 is similar to that of the female. The coxa of gnathopod 2 is straight along its posterior margin and convex along its ventral margin; the anterior margin of the lateral flange of the basis bears stridulation ridges. In the earliest recognizable males, the palm of the propodus is transverse, without palmar teeth; in later instars, the hinge and central teeth and thumb are little separated and of the same length, the hinge tooth is not bifid, and the thumb is not directed posteriorly from the propodus; the posterior margin of the dactyl is evenly concave, without a protuberance or crenulation, but with one distal cusp. In late instar males the antenna 2 is pediform and sparsely setose. The stridulation ridges on the anterior margin of the basis and ventral margin of the coxa of gnathopod 2 are absent or rare. Other variants are as follows: uropod 3, peduncle with 1–2 terminal spines but none medially, outer ramus (any age, either sex), number of cusps varying from 2 to 5. Gnathopod 2, earlier instar females, palm convex; pereiopods 2–5, brood plates without setae or absent entirely.

Type Material Examined.—Holotype, adult male, and paratypes, 1 adult male and 2 adult females, Bahía Magdalena, Baja California, dredge at 10–15 m depth, 18 July 1938, W. L. Schmitt, collector (USNM: catalogue no. 79369, station 3-38).

Other Material Examined.—BAJA CALIFORNIA AND GULF OF CALIFORNIA: Sixteen adult males, 26 adult females, 19 juveniles, Topolobampo and Bahía de Los Angeles, Gulf of California; Bahía Magdalena and Bahía de San Quintin, outer Baja California, February, March, April, May, July (USNM: catalogue nos. 128299, 174975, 174976, 239388, 239388, ALBATROSS station nos. 1885 and 2405, and J. L. Barnard stations TOP-3 and Tortugas station 9). Females ovigerous March and April.

Remarks.—*Microjassa macrocoxa* (any age, either sex) can be separated from all species of *Microjassa* but *M. tetradonta* and *M. floridensis* by the lack of a ventral spinous process on the peduncle of uropod 1. From the latter the male is distinguished by the presence of stridulation ridges on coxa 3 and the wide, minutely cusped flange on the second gnathopod basis. From *M. floridensis* the male can also be recognized by the essentially transverse appearance of the second gnathopod: in *M. macrocoxa* the palmar thumb originates distally on the posterior margin of the propodus and extends to the level of the hinge tooth, while in *M. floridensis* the thumb originates proximally, as in *M. cumbrensis* and *M. boreopacifica,* thus giving the palm the appearance of being convex or straight.

In adult males of *M. macrocoxa* the anterior setae at the dactyl origin of gnathopod 2 are much shorter than in *M. floridensis* and the second antenna is enlarged and barely setose. From *M. tetradonta,* adult male *M. macrocoxa* are also distinguished by the presence of one, rather than two teeth in the palm of the propodus of gnathopod 2. However this is not a distinguishing feature in young males where the palmar teeth are small and the central tooth is single in both species. *Microjassa macrocoxa* and *M. tetradonta* are the only species of *Microjassa* which have an enlarged second antenna and transverse palmed second gnathopod in the male. In young males the hinge tooth is single and the dactyl fits against it, terminating at the thumb. In larger males, the hinge tooth is bifid and the crenulations of the dactyl rest between the teeth. The tip of the dactyl closes on the medial side of the thumb. The toothing arrangement is thus triangular, with the thumb angled laterally and the central tooth medial to the hinge tooth.

Females of *M. macrocoxa, M. tetradonta,* and *M. floridensis* can only be separated on the basis of co-occurrence with males. However the distribution of *M. macrocoxa* is Pacific, while that of *M. tetradonta* and *M. floridensis* is Atlantic.

Distribution.—Confirmed: Western Baja California: Bahía de San Quintin to Bahía Magdalena; Gulf of California: Topolobampo. High salinity exposed coasts, low intertidal to 54 m depth on sand and sandy silt bottoms.

Microjassa tetradonta new species
Figure 3

Diagnosis.—Uropod 1 without peduncular spinous process. Uropod 3, outer ramus with 3–5 terminal cusps. Pereiopods 3 and 4, carpus 40–50% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male, gnathopod 2 with minute nodules on basis and crenulations on coxa 3 medial face for stridulation; propodus resembling that of *M. macrocoxa,* but with 2 central teeth. Adult female, gnathopod 2 propodus, palm slightly excavate, marked by abrupt change in angle at position of defining spines.

Description.—ADULT MALE. Holotype: Length 2.2 mm. Without antenna 1. Antenna 2, peduncle setae longer than peduncle width; flagellum 2 articles. Mandibular palp, article 3, W:L = 0.53. Pereiopods 1–4, basis, posteromedial margin with up to 3 setae. Gnathopod 1, coxa:coxa 2, L = 0.36; basis, anterior margin

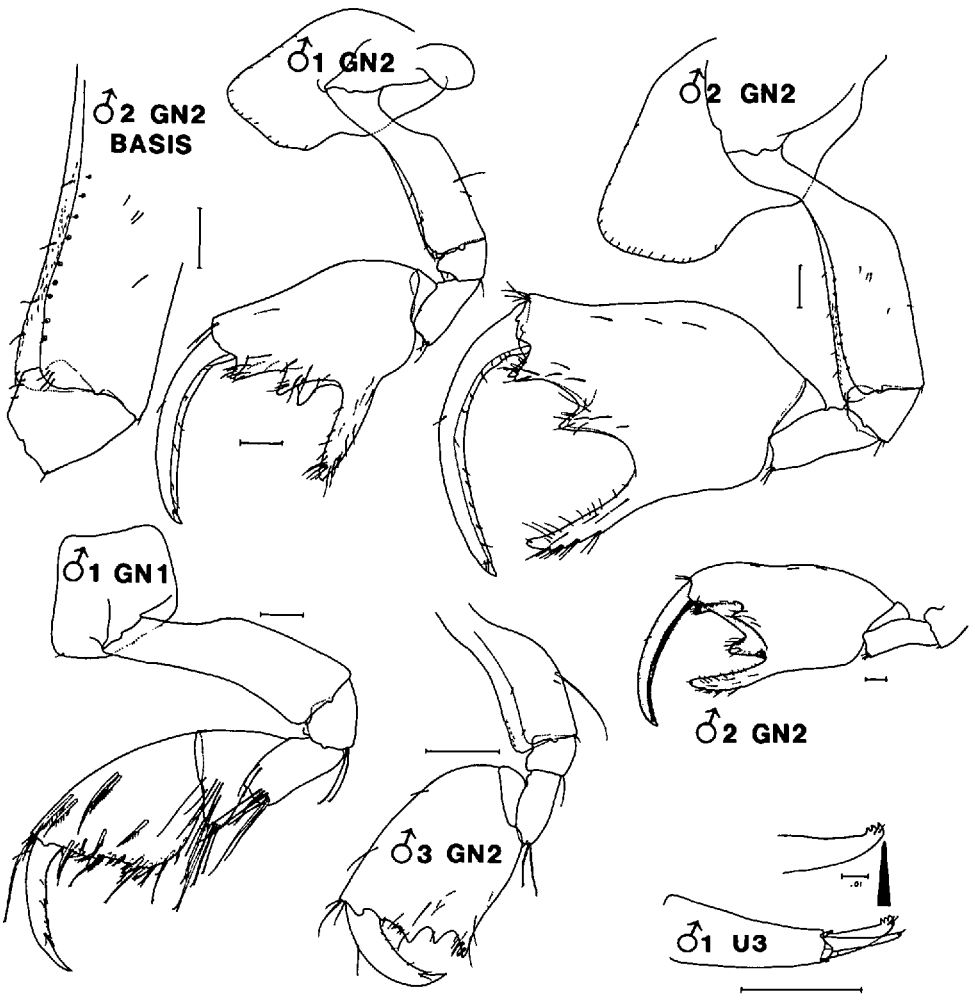


Figure 3. *Microjassa tetradonta* n. sp. Male 1, holotype, 2.2 mm and juvenile male 3, 1.4 mm, station P146; male 2, 2.9 mm, station P291; Gulf of Mexico, 40 km off Panama City, Florida, 21 November 1964. Oblique view: male 2 gnathopod 2 palm area; other views medial. Scale 0.1 mm.

not spinose; carpus, anterodistal margin without seta, posterior lobe : anterior margin, L = 0.47; propodus, palm defined by change in angle; dactyl with 4 cusps. Gnathopod 2, coxa without stridulation ridges, ventral margin straight, posterior margin sinuous; basis inserted slightly dorsally to mid-point of coxa 2, basis not spinose, but with row of short setae on anteromedial flange and minute nodules between lateral and medial flanges, lateral flange narrow, tapering gradually to junction of coxa; carpus : propodus, L = 0.27, anterodistal margin and posterior lobe without setal groups; propodus, anterior margin sinuous, without setose protuberance and row of spines, setae at dactyl hinge short, less than half length of dactyl, palm strongly excavate and weakly setose, hinge tooth bifid to accommodate dactyl, with short lateral and medial teeth between hinge tooth and thumb, thumb : propodus, L:W = 0.83, thumb originating distally, straight, but directed about 45° from posterior margin of propodus, tip with small defining spine; dactyl : propodus, L = 0.87, posterior margin without crenulation or protuberance,

inner marginal setae: dactyl, L:W = 0.41, outer margin without row of short setae. Pereiopod 3, coxa: coxa 4, L = 1.00, coxa 3, medial face finely crenulated; carpus 0.47 overlapped by merus. Pereiopod 5, coxa: coxa 4, L = 0.32. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 5 spines, without posteroventral spinous process. Uropod 3, peduncle with 2 distal spines but no medial spines, outer ramus terminating in 3 cusps and 2 fine setae, but without recurved spine. Telson with pair of erect setae, but without spines or cusps.

CONDITION. Without antenna 1, right antenna 2, right pereiopod 3, or right and left pereiopods 5–7.

ADULT FEMALE. Allotype: Length 2.7 mm. Without antennae 1 and 2. Gnathopod 1, coxa: coxa 2, L = 0.44. Gnathopod 2, coxa, ventral margin broadly convex, posterior margin shallowly excavate; basis, medial flange without setal row or nodules; carpus: propodus, L = 0.32; propodus and dactyl similar in shape to and only slightly larger than propodus of gnathopod 1, palm slightly excavate, marked by abrupt change in angle at position of defining spines. Pereiopod 3, coxa: coxa 4, L = 1.59, W = 0.70. Uropod 3, outer ramus terminating in 5 cusps and 2 setae (left), 5 cusps and 1 seta (right). Other character states as in male.

CONDITION. Ovigerous, without antennae 1 and 2, left pereiopods 3–7, or right pereiopods 5–7.

VARIATION. Length: male up to 2.9 mm (although reported to 5.0 mm by Culpepper, 1969), female up to 2.7 mm. Young males differ from later instars in the appearance of the antenna 2 and gnathopod 2. In the youngest recognizable males the antenna 2 is similar to that of the female. The posterior margin of the coxa of gnathopod 2 is straight and the ventral margin broadly convex; the palm of the propodus is transverse, the hinge and central teeth are little separated from the thumb and of the same length, the hinge and central teeth are single, and the thumb is not directed posteriorly from the propodus; the posterior margin of the dactyl has one distal cusp. In later instar males the hinge tooth on the propodus of gnathopod 2 becomes bifid, the central tooth divides, and the thumb becomes longer and directed more posteriorly from the palm, the tip curving anteriorly. According to Culpepper (1969), the second gnathopod dactyl of largest males develops a small protuberance proximally and a broader expansion centrally. There is also a reduction in number of cusps on the uropod 3 outer ramus: 5–6 in juveniles to 2–5 in larger individuals. In early instar females the palm of gnathopod 2 is convex, and the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material.—Holotype, adult male, Gulf of Mexico, 29°49.5'N, 86°06.9'W, 40 km off Panama City, Florida, 21 November 1964, amongst fouling community on a float submerged at 44 m depth, W. E. Pequegnat, collector (CMN: catalogue no. NMCC1986-149, station no. P146, F-3U). Paratypes, 25 adult males, same location as for holotype (CMN: catalogue no. NMCC1986-151). Allotype, adult female, Gulf of Mexico, 30°00.6'N, 85°54.2'W, 18 km offshore of Panama City, Florida, on float submerged at 29 m depth, 13 June 1964, W. E. Pequegnat, collector (CMN: catalogue no. NMCC1986-150, station no. P26, F1U). Paratypes, 6 adult males, 1 adult female (CMN: catalogue no. NMCC1986-152), same location as for allotype.

Other Material Examined.—(16 adult males, 8 adult females, 3 juveniles) SOUTH CAROLINA: 1 adult male, offshore, 32°40'N, 78°47'W, 37 m depth, 13 May 1977 (USNM: catalogue no. 174976). FLORIDA: 15 adult males, 8 adult females, 3 juveniles, Atlantic: offshore, 30°23'N, 80°26'N, 39 m depth, 1 March 1977 (USNM: catalogue no. 174975); Gulf of Mexico: offshore, 29°16.30'N, 85°32.00'W, 45.7 m depth, 7 February 1885 (USNM: ALBATROSS Expedition, station 2369-74); offshore, 28°45'N, 85°02'W, 54 m depth, 15 March 1885 (USNM: ALBATROSS Expedition, station 2405); same locality as for types, 18 km offshore, 29 m depth, annual temperature range at this depth 13–29°C, February, June, September (CMN: station nos. P243, F-1; P307, F-1; P417, F-1U); 40 km offshore, 44 m depth, February, March, May, July (CMN: station nos. P261, F-3U; P291, F-3; P343,

F-3U; P460, F-3U) (CMN: catalogue nos. NMCC1989-0811 to NMCC1989-0817). Females ovigerous in March and June.

Remarks.—*Microjassa tetradonta* closely resembles *M. macrocoxa,* and females and juvenile males cannot be distinguished. However, *M. tetradonta* is only known from the Gulf of Mexico and the Atlantic coast of the southern United States, while *M. macrocoxa* is only known from the Pacific coast of Baja California and the Gulf of California. Later instar males of *M. tetradonta* resemble *M. macrocoxa* in the enlargement of the second antenna, sinuosity of the second coxa, lack of a peduncular spinous process on uropod 1, lack of medial spines on the uropod 3 peduncle, and cusping of the uropod 3 outer ramus. However *M. tetradonta* can be distinguished by other characteristics of the second gnathopod: lack of stridulatory cusps on the anterior margin of the basis (and also on coxa 3), an evenly tapering lateral flange, presence of minute nodules and a row of short setae on the medial flange, and presence of two central teeth in the palm, giving a 3-dimensionality to it, rather than one central tooth and a more flattened, 2-dimensional palm as in *M. macrocoxa.* In some adult males the lateral tooth is smaller than the medial tooth and above the palm, rather than on the lateral margin, thus making this species easily mistaken for *M. macrocoxa.*

Females and juveniles can be distinguished from other species but *M. macrocoxa, M. tetradonta,* and *M. floridensis* by the lack of the uropod 1 peduncular spinous process, the shape of the second gnathopod, and the cusping pattern of the third uropod outer ramus.

Pequegnat and Pequegnat (1968) and Culpepper (1969) refer to this species as *M. macrocoxa.* However on examining their specimens, they are clearly *M. tetradonta.* Culpepper (1969) illustrates gnathopod 2 development for the male. Pequegnat and Pequegnat (1968) collected this species at both 18 and 40 km offshore, but not at 3 km offshore of Panama City, Florida, concluding that its biogeographic affinity was with Caribbean biota. Over 1,000 specimens were collected from floats submerged at 4–44 m depth, with few shallower than 10 m and greatest density at 44 m depth, thought possible due to a reduction of hydroid growth. Colonization of the submerged floats occurred at all times of the year. Water temperatures ranged from 13 to 27°C at the bottom and 15 to 31°C at the surface. Co-occurring Corophioidea were *Jassa marmorata* (reported as *J. falcata*), *Ericthonius brasiliensis,* and *Podocerus brasiliensis* (identifications not confirmed for the latter two species). However these species were most common at the 3 km station where *M. tetradonta* did not occur.

Etymology.—Greek, *tetra* = four, *odontos* = tooth, in reference to the four teeth on the male's second gnathopod palm.

Distribution.—Atlantic Ocean and Gulf of Mexico, offshore of South Carolina and Florida. Fouling submerged buoys and collected by beam trawl at 29–54 m depth on high salinity, exposed coasts.

Microjassa bahamensis new species
Figure 4

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 4–5 cusps. Pereiopods 3 and 4, carpus 10% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male gnathopod 2, coxa and basis with stridulation ridges; propodus without thumb, defining spine large, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm slightly excavate, marked by abrupt change in angle at position of defining spines.

Description.—ADULT MALE. Holotype: Length 1.5 mm. Antenna 1 : antenna 2, L = 0.85; antenna 2, peduncle setae longer than peduncle width; flagellum 2 articles. Mandibular palp, article 3, W:L = 0.64. Pereiopods 1–4, basis, posteromedial

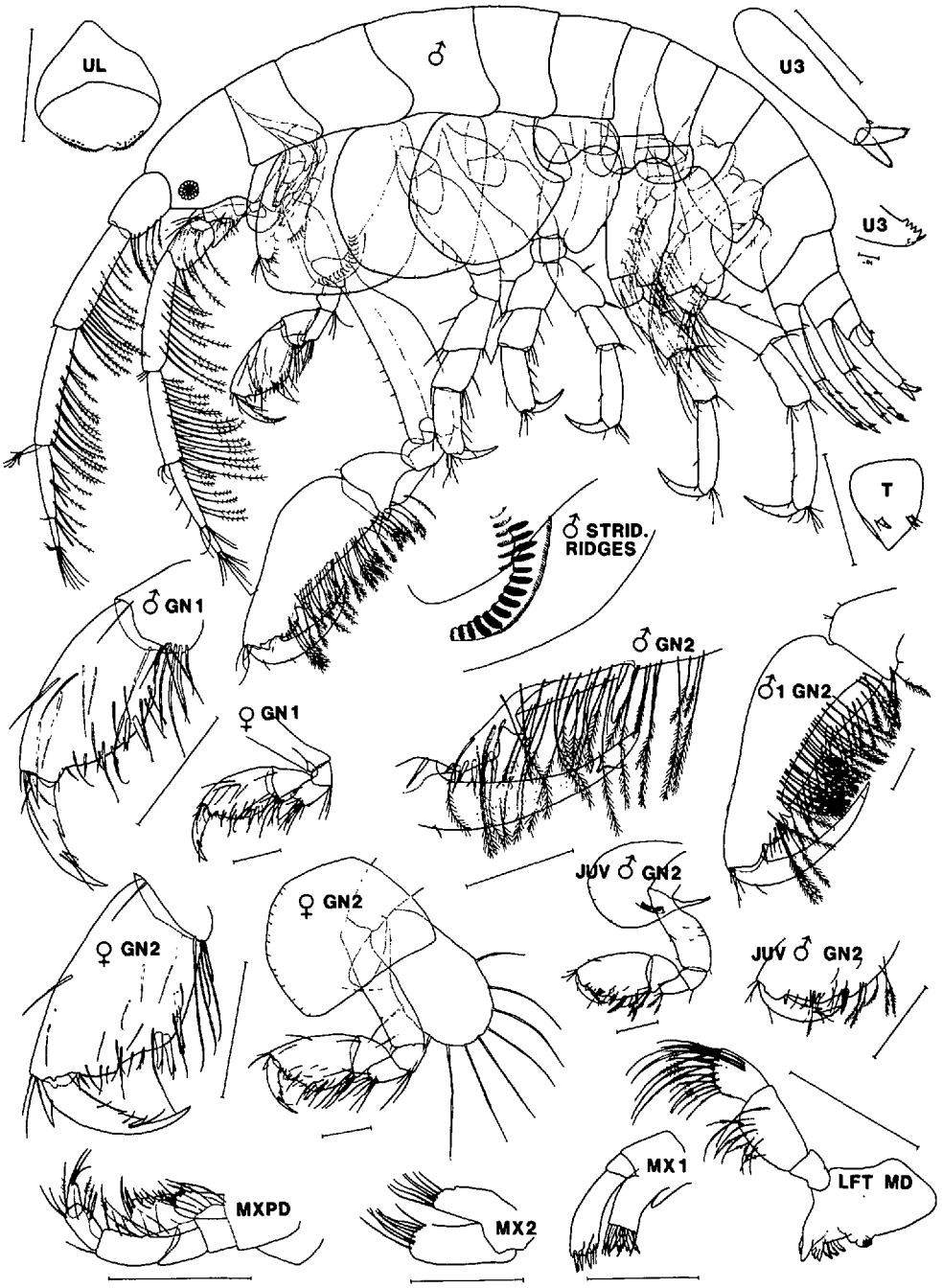


Figure 4. *Microjassa bahamensis* n. sp. Male, holotype, 1.5 mm; allotype, adult female, 1.5 mm; paratypes, male 1, 1.9 mm; juvenile male, 1.2 mm; Andros Island, Bahama Islands, 1981. Note that even the juvenile male possesses stridulating ridges on the second gnathopod, while the female does not. Lateral views: whole body, uropod 3, upper lip, maxillae 1 and 2, mandible, and female gnathopods 1 and 2; dorsal view: telson; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm unless indicated otherwise.

margin without long setae. Gnathopod 1 coxa: coxa 2, L = 0.52; basis, anterior margin not spinose; carpus, anterodistal margin with 1 seta, posterior lobe: anterior margin, L = 0.55; propodus, palm not defined by change in angle; dactyl with 2 cusps. Gnathopod 2, coxa with stridulation ridges medially, ventral margin broadly convex and slightly excavate, posterior margin convex; basis inserted ventral to mid-point of coxa 2, basis not spinose, anterolateral flange tapering gradually to coxal insertion, without nodules, but with stridulation ridges near junction of coxa; carpus: propodus, L = 0.40, anterodistal margin with 1 setal group, posterior lobe with 2 setal groups; propodus, anterior margin sinuous, without setose protrusion and row of spines, setae at dactyl hinge short, less than half length of dactyl, palm straight with abundant plumose setae, hinge teeth sequential, without thumb or central tooth, but with strong defining spine ½ palmar setal length; dactyl: propodus, L = 0.62, not posteroproximally crenulate, without posteroproximal protuberance, inner marginal setae: dactyl, L:W = 0.33, outer margin without row of short setae. Pereiopod 3, coxa: coxa 4, L = 1.01, coxa 3 without fine striations on medial face; carpus 0.10 overlapped by merus. Pereiopod 5, coxa: coxa 4, L = 0.40. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 2 spines, posteroventral spinous process: peduncle, L = 0.09. Uropod 3, peduncle with 1 terminal spine but no medial spines, outer ramus terminating in 4 cusps, without terminal setae but with basally immersed, dorsally recurved spine. Telson with pair of strong spines and short setae but without cusps.

CONDITION. With all appendages.

ADULT FEMALE. Allotype: Length 1.5 mm, Antenna 1: antenna 2, L = 0.96. Gnathopod 1, without coxa. Gnathopod 2, coxa without stridulation ridges, ventral margin broadly convex, posterior margin convex; basis inserted dorsal to mid-point of coxa, basis without stridulation ridges; carpus: propodus, L = 0.47, propodus and dactyl similar in shape to and only slightly larger than propodus of gnathopod 1, palm slightly excavate, marked by abrupt change in angle at position of defining spines. Pereiopod 3, coxa: coxa 4, L = 0.96, W = 0.77. Uropod 3, peduncle with 2 distal spines, outer ramus terminating in 5 cusps. Other character states as in male.

CONDITION. Without right coxa 1; all other appendages present.

VARIATION. Length: male up to 1.9 mm, female up to 1.5 mm. Very young male instars differ from the adult in the second gnathopod being more similar to the first; however stridulation ridges are present early. In both males and females the uropod 3 peduncle has 0–1 medial spines and 1–2 terminal spines, and the outer ramus has 4–5 cusps. In early instar females the palm of gnathopod 2 is convex and the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material.—Holotype, adult male, Andros Island, either from Rat Cay or Bulehole Cay (precise location not documented), British Blue Holes Expedition 1981–82, August 1981, 5–20 m depth, G. F. Warner, collector (USNM: catalogue no. 266417). Allotype, adult female, same locality (USNM: catalogue no. 266418). Paratypes, 18 adult males, 13 adult females, 19 juveniles, same locality (USNM: catalogue no. 266419). Most females ovigerous.

Other Material Examined.—None.

Remarks.—The appearance of males of this species changes less from juvenile to adult than does that of males that develop teeth in the palm of the gnathopod 2. The appearance of the male's second gnathopod is highly characteristic. In no other species of *Microjassa* is the basis of gnathopod 2 inserted so low on the coxa, are stridulation ridges present on coxa 2 (and on juveniles as well), is the carpus so long, is the palm so densely setose and straight, or the defining spine

so large. Pereiopods 3 and 4 are also distinctive in the small degree of overlap of the merus over the carpus. Pereiopods 5–7 vary more greatly in size than do those of *M. litotes*. The peduncular process under the rami of uropod 1 is short, but visible under high magnification. The third uropod cusping and spine resembles that of *M. floridensis* rather than *M. boreopacifica*. The juvenile gnathopod 2 of *Ischyrocerus oahu* J. L. Barnard, 1970 and *I. oahu armatus* Ledoyer, 1979 superficially resembles that of *Microjassa bahamensis*. However, both species of *Ischyrocerus* lack the coxal form characteristic of *Microjassa*. As well, in neither species of *Ischyrocerus* is the outer ramus of uropod 3 terminated by a spine.

The collecting locality for *M. bahamensis* is described by Warner and Moore (1984). According to Warner (pers. comm.), *M. bahamensis* was collected in the plankton at the entrance of Rat Cay or Bluehole Cay during the "blow" phase of the cave current (i.e., exit current, with can reach 50 cm per second). Warner (pers. comm.) considers that the specimens were probably dislodged by the current and that they normally constructed tubes on the cave walls amongst sponges, hydroids, and corals. Although in such a location there was a lack of light, other features, such as water temperature and salinity approximated surface conditions. There were no cave adaptations evident in the morphology of *M. bahamensis*, such as reduction in eye structure and/or increase in leg length. Body pigmentation in life is unknown.

Microjassa bahamensis was termed "*Microjassa* sp. B" in Conlan (1988).

Etymology.—In reference to the type location.

Distribution.—Andros Island, Bahama Islands, in a cave, 5–20 m depth, high salinity.

Microjassa boreopacifica new species
Figure 5

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 4–7 cusps. Pereiopods 3 and 4, carpus 40–50% overlapped by merus. Gnathopod 1, basis anterodistally spinose. Adult male gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face, presumably for stridulation; propodus with short thumb originating proximally, defining spine minute, anterior margin with row of spines. Adult female, gnathopod 2 propodus, palm slightly excavate, not marked by abrupt change in angle at position of defining spines.

Description.—ADULT MALE. Holotype: Length 3.0 mm. Without antennae 1 and 2 (paratype, male, 2.2 mm, antenna 1 : antenna 2, L = 0.79; peduncle setae longer than peduncle width; flagellum 3 articles). Mandibular palp, article 3, W:L = 0.59. Pereiopods 1–4, basis, posteromedial margin with up to 3 moderately long setae. Gnathopod 1, basis anterodistally spinose medially; carpus, anterodistal margin with 1 seta, posterior lobe : anterior margin, L = 0.52; propodus, palm not defined by change in angle; dactyl with 1 cusp. Gnathopod 2, coxa without stridulation ridges, ventral margin convex, posterior margin excavate; basis inserted dorsal to mid-point of coxa; basis not spinose, but with minute nodules between anterolateral and medial flanges; lateral flange moderately abruptly narrowed dorsally, without stridulation ridges; carpus : propodus, L = 0.08, anterodistal margin and posterior lobe without setae; propodus, anterior margin convex, without setose protuberance, but with row of spines, setae at dactyl hinge short, less than half length of dactyl, palm concave and moderately setose, hinge teeth sequential, without additional tooth between hinge tooth and thumb, thumb : propodus, L:W

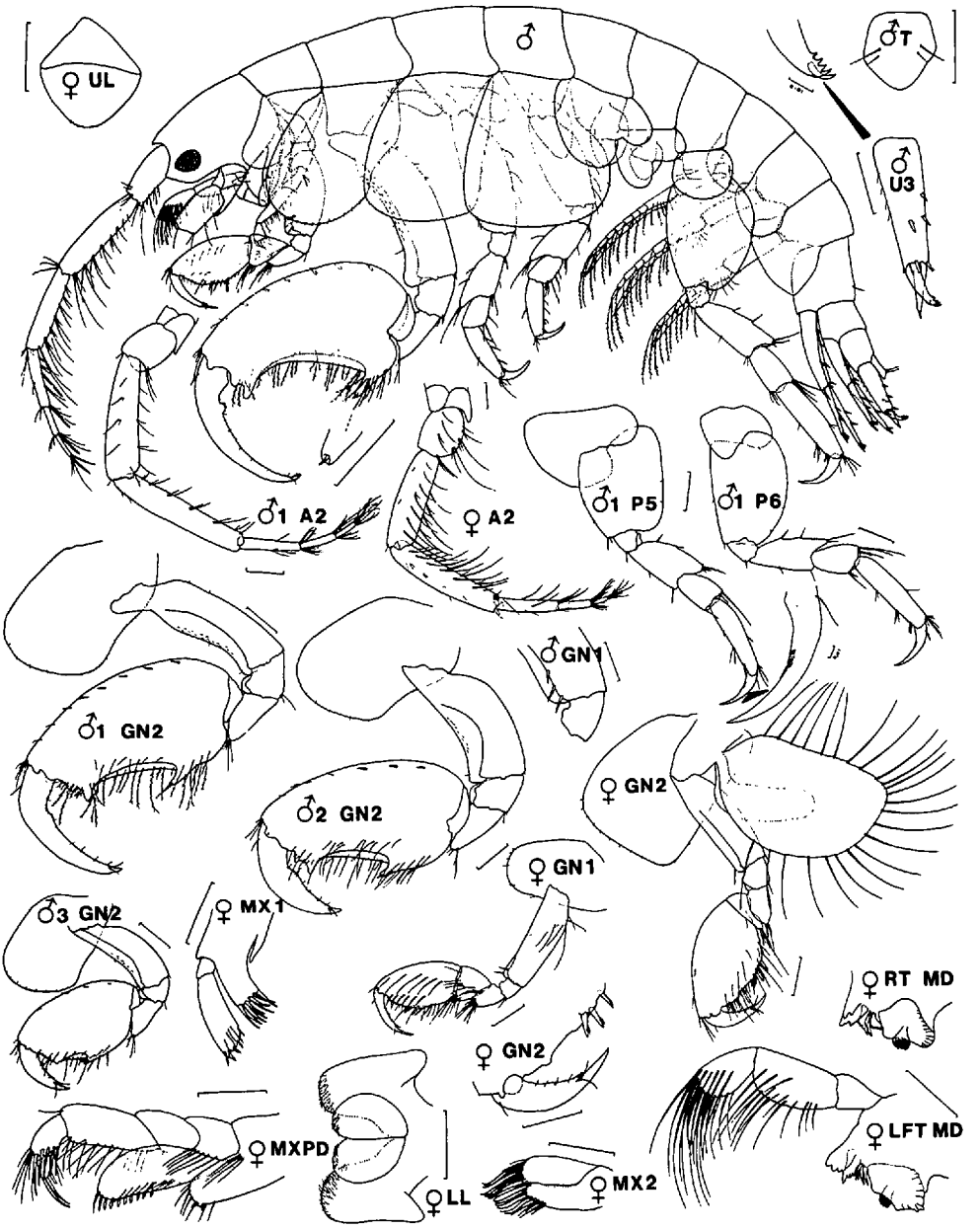


Figure 5. *Microjassa boreopacifica* n. sp. Holotype, male, 3.0 mm; allotype, adult female, 2.9 mm; paratypes, male 1, 2.2 mm, male 2, 2.4 mm, male 3, 1.7 mm; Port McNeil, Vancouver Island, British Columbia, 26 July 1976. Note the growth stages in the male gnathopod 2 and spination of the basis of the male gnathopod 1. Lateral views: whole body, uropod 3, maxilla 1, and left mandible; dorsal view: telson; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm unless indicated otherwise.

= 0.22, thumb originating proximally, straight, but directed 30° from posterior margin of propodus, tipped with minute defining spine; dactyl: propodus, L = 0.76, not posteroproximally crenulate, with 1 posteroproximal protuberance, inner marginal setae: dactyl, L:W = 0.19, outer margin without row of short setae. Pereiopod 3, coxa: coxa 4, L = 0.98; coxa 3, medial face finely crenulated, carpus 0.45 overlapped by merus. Pereiopod 5, coxa: coxa 4, L = 0.55. Urosome 1 with pair of erect setae dorsally. Uropod 1, peduncle with 6 spines, posteroventral spinous process: peduncle, L = 0.13. Uropod 3, peduncle with 3 medial and 2 distal spines, outer ramus terminating in 4 cusps and basally immersed, dorsally recurved spine, but without setae. Telson with 2 setae and 2 cusps at each apex but without spines.

CONDITION. Without antennae or pereiopods 5 and 6.

ADULT FEMALE. Allotype: Length 2.9 mm. Antenna 1: antenna 2, L = 0.81; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles. Pereiopods 1–4, basis, posteromedial margin with up to 6 setae. Gnathopod 1, coxa: coxa 2, L = 0.69; carpus, anterodistal margin without setal group. Gnathopod 2, coxa, ventral margin straight, posterior margin straight; basis without nodules, lateral margin tapering gradually to junction of coxa; carpus: propodus, L = 0.20, anterodistal margin with 1 setal group, posterior lobe with 3 setal groups; propodus and dactyl similar in shape to and only slightly larger than those of propodus of gnathopod 1, palm slightly excavate, not defined by abrupt change in angle. Pereiopod 3, coxa: coxa 4, L = 0.98, W = 0.74. Uropod 1, peduncle with 7 spines. Uropod 3, peduncle with 2 medial and 2 distal spines; outer ramus with 7 terminal cusps plus recurved spine. Other character states as in male.

CONDITION. Ovigerous, without left antennae 1 and 2.

VARIATION. Length: male up to 3.0 mm, female up to 2.9 mm. The males differ in the appearance of antenna 2 and gnathopods 1 and 2. In the earliest recognizable males the antenna 2 is similar to that of the female. The basis of gnathopod 1 is not spinose. The posterior margin of the coxa of gnathopod 2 is straight; the anterior marginal spines on the propodus are short and seta-like, the hinge tooth and thumb are short, the thumb is more distal and not directed at an angle from the posterior margin of the propodus, the dactyl is wider, and the posterior margin lacks a protuberance, being evenly concave or sinuous. In both sexes and at any age the anterodistal setae on the carpus of gnathopod 1 are minute or absent. The posteromedial margin of pereiopods 1–4 has 1–6 setae. The peduncle of uropod 1 has 4–7 spines, the peduncle of uropod 3 has 3–5 spines, and the outer ramus of uropod 3 has 4–7 cusps. In early instar females the palm of gnathopod 2 is evenly convex and the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material.—Holotype, adult male, Port McNeill, Vancouver Island, B.C., scraping of rocks and algae in the low intertidal zone, water temperature 9.0°C, salinity 34 ppt, 26 June 1976, R. O'Clair, collector (CMN: catalogue no. NMCC-1985-501, station 760040). Allotype, adult female, same locality (CMN: catalogue no. NMCC1985-502). Paratypes, 5 adult males, 5 adult females, 8 juveniles, same locality (CMN: catalogue no. NMCC1985-503).

Other Material.—(13 adult males, 23 adult females, 16 juveniles) SOUTHEASTERN ALASKA: 1 adult male, 1 adult female, Ogden Passage, July (CMN: accession and station nos. 1980-357, S14L1). BRITISH COLUMBIA: 12 adult males, 22 adult females, 16 juveniles, Vancouver Island, St. John Harbour to Victoria; mainland, Sutton Island to English Bay; June, July, August, September (CMN: catalogue nos. NMCC1993-0016 to 0030, accession and station nos. 1959-112, N11, V3; 1964-198, H50, H53; 1967-224; 1976-157, B25, EB8; 1976-158, 101/76; 1976-171, 760014; 1977-181, B19a; 1977-328; 1978-61, 77-5048). Females ovigerous June–September.

Remarks.—Color: In life, eyes red. Body cuticle shiny, basally white or clear, banded at each segment with brown. Width of banding and intensity of pigmen-

tation variable. *Microjassa boreopacifica* is unique in lacking an indentation on the lower lip. It is also recognizable from other species of *Microjassa* by the pair of erect setae on the dorsum of urosome 1. Although *M. bahamensis* and *M. floridensis* also possess a dorsally recurved spine on the uropod 3 outer ramus, this spine is larger and more obvious in *M. boreopacifica*. Even the smallest recognizable males possess a small but distinct thumb on the second gnathopod. The spinosity of the later instar first gnathopod basis is distinctive in the male and female. From other Pacific coast females, the female of this species is distinguishable by the more even merging of the palm with the posterior margin of the propodus on the second gnathopod. *Microjassa boreopacifica* was termed "*Microjassa* sp. P" in Conlan (1988).

Etymology.—In reference to its boreal Pacific distribution.

Distribution.—Ogden Passage, southeastern Alaska to Victoria, British Columbia. Collected in dip net scoops or dredges through eelgrass, algae, shell, coral, mud, sand, and gravel from the low intertidal zone to 61 m depth. Recorded temperature and salinity range were 9.0–14.2°C and 30.3–34.5‰ respectively.

Microjassa cumbrensis (Stebbing and Robertson)
Figure 6

Podocerus cumbrensis Stebbing and Robertson, 1891, 38. Walker, 1895, 316.
Microjassa cumbrensis (Stebbing and Robertson). Stebbing, 1899, 240; 1906, 651. Chevreux and Fage, 1925, 350. Bellan-Santini and Ledoyer, 1973, 917. Krapp-Schickel and Schiecke, 1974, 404. Lincoln, 1979, 564. Moore, 1984, 65. Myers, 1989b, 439. J. L. Barnard and G. S. Karaman, 1991, 214.
Jassa falcatiformis (Sowinsky, 1898), *Podocerus falcatiformis* + *Ischyrocerus constantinopolitanus* (juvenile), 461 and 463.
Ischyrocerus? sp.: Ledoyer, 1979, 96.

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 7–13 cusps. Pereiopods 3 and 4, carpus 30–40% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face for stridulation; propodus with long thumb originating proximally, defining spine minute, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm convex.

Description.—ADULT MALE. (Description of adult male from Loch Riddon, Argyll, Scotland.) Length 2.5 mm. Antenna 1 : antenna 2, L = 0.77; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles. Mandibular palp, article 3, W:L = 0.38. Pereiopods 1–4, basis, posteromedial margin with up to 3 setae. Gnathopod 1, coxa : coxa 2, L = 0.34; basis, anterior margin not spinose; carpus, anterodistal margin without seta, posterior lobe : anterior margin, L = 0.37; propodus, palm not defined by change in angle; dactyl with 1 cusp. Gnathopod 2, coxa without stridulation ridges, ventral margin convex, posterior margin slightly excavate; basis inserted dorsal to mid-point of coxa, basis not spinose, with minute nodules between lateral and medial flanges, lateral flange tapering gradually to coxal insertion, without stridulation ridges; carpus : propodus, L = 0.05, anterodistal margin and posterior lobe not setose; propodus, anterior margin convex, without setose protrusion and row of spines, setae at dactyl hinge short, less than half length of dactyl, palm concave and weakly setose, hinge teeth sequential, tooth more distal to dactyl hinge being larger, palm without additional tooth between hinge tooth and thumb, thumb : propodus, L:W = 1.31, thumb originating

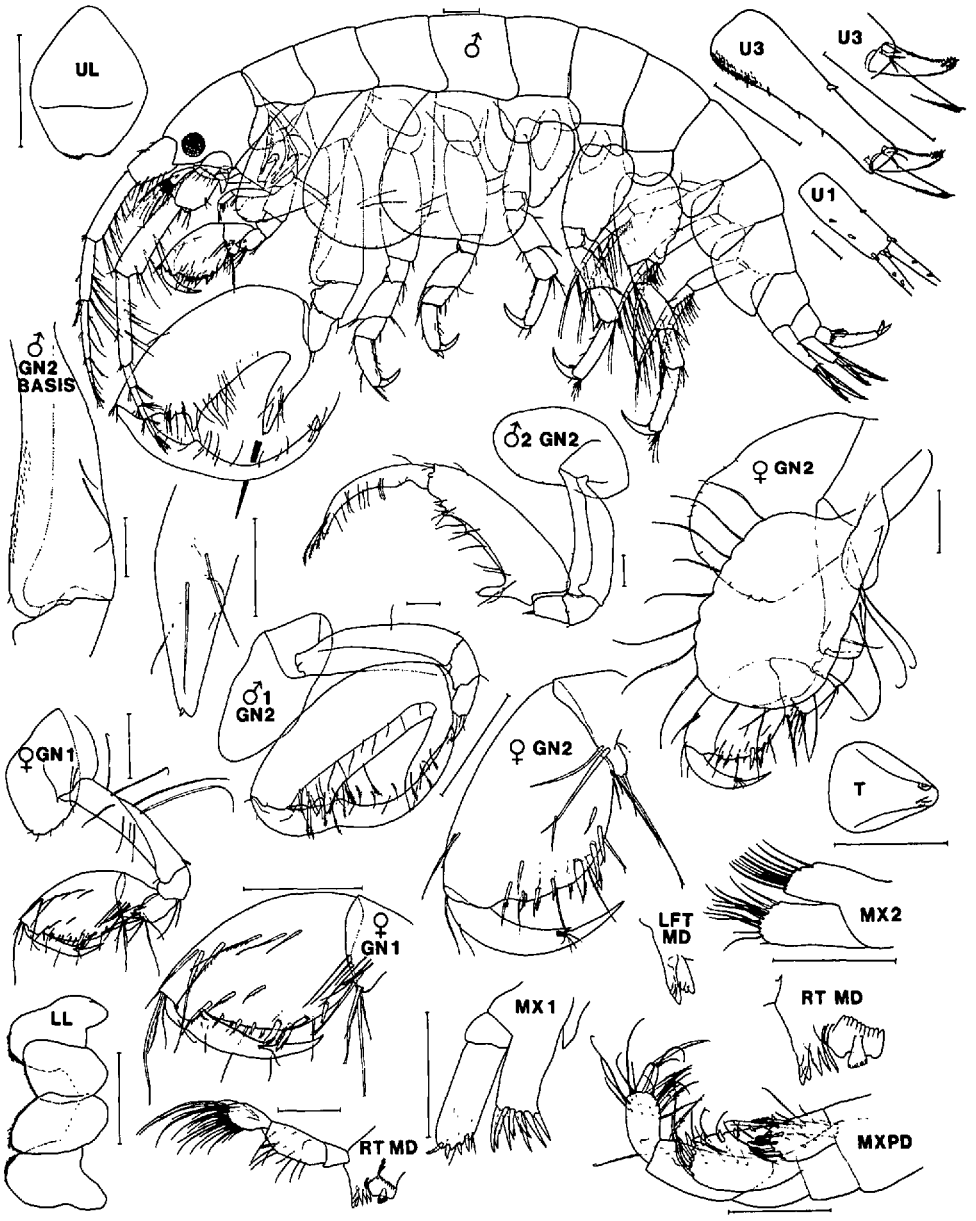


Figure 6. *Microjassa cumbrensis* (Stebbing and Robertson). Male, 2.5 mm, adult female, 2.2 mm, Loch Riddon, Argyll, Scotland. Male 1, 2.7 mm, Plymouth, England. Male 2, 2.4 mm, Black Head, Galway Bay, Ireland, 26 August 1981. Note the variation in the appearance of the male gnathopod 2, the presence of small nodules on the anterior margin of the basis, and the small spine at the tip of the palmar defining tooth. Lateral views: whole body, upper lip, uropod 3, and male gnathopod 2 basis and palmar defining tooth magnifications; dorsal view: telson; other views medial. Appendages of the male, 2.5 mm, unless indicated otherwise. Scale 0.1 mm.

proximally, curved posteriorly, with minute spine at tip; dactyl:propodus, L = 1.07, not posteroproximally crenulate, with 1 posteroproximal protuberance, inner marginal setae:dactyl, L:W = 1.63, outer margin without row of short setae. Pereiopod 3, coxa:coxa 4, L = 1.00, coxa, medial face finely crenulated; carpus 0.37 overlapped by merus. Pereiopod 5, coxa:coxa 4, L = 0.27. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 5 spines, posteroventral spinous process:peduncle, L = 0.11. Uropod 3, peduncle with 1 medial and 2 distal spines, outer ramus terminating in 11 cusps and 2 setae, but without terminal recurved spine. Telson with 2 setae and 2 minute cusps at each apex but without spines.

CONDITION. All appendages present.

ADULT FEMALE. (Description of female from Loch Riddon, Argyll, Scotland.) Length 2.2 mm. Antenna 1:antenna 2, L = 0.95; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles. Pereiopods 1–4, posteromedial margin with up to 8 setae. Gnathopod 1, coxa:coxa 2, L = 0.35. Gnathopod 2, coxa, posterior margin straight; basis without nodules; carpus:propodus, L = 0.37; propodus and dactyl similar in shape to and only slightly larger than propodus of gnathopod 1, palm slightly excavate, not marked by abrupt change in angle at position of defining spines. Pereiopod 3, coxa:coxa 4, L = 1.01, W = 0.70. Uropod 1, peduncle with 4 spines. Uropod 3, outer ramus terminating in 13 cusps and 1 seta (right) and 10 cusps and 2 setae (left). Telson apex with 2 cusps (right) and 4 cusps (left) posterior to setal origin. Other character states as in male.

CONDITION. Ovigerous, with all appendages.

VARIATION. Length: male up to 3.0 mm, female up to 2.5 mm. Earliest recognizable males differ from later instars in the following respects: gnathopod 1, coxa:coxa 2, length less disproportionate (L = 0.44 in male, 2.6 mm from Galway Bay, Ireland); pereiopods 1–4, basis with maximum 1–8 posteromedial setae. Gnathopod 2, basis without nodules; propodus, thumb smaller, originating more distally, palm may have small central tooth in addition to 2 hinge teeth, hinge teeth more similar in size, dactyl shorter than propodus, posterior margin evenly concave or slightly sinuous with long setae throughout or with 1 group of apical setae that are longer than marginal setae. In later instars thumb longer, straight or posteriorly recurved, originating more proximal to carpus; dactyl longer and more curved, setae shorter, and protuberance central or proximal. Pereiopod 4, coxa:coxa 5, L = 0.35–0.57. In males and females the uropod 1 peduncle has 3–5 spines; peduncular process:peduncle, L = 0.11–0.21. Uropod 3, outer ramus with 7–13 cusps. Telson apex with 2–4 cusps basal to 1–2 setae. In early instar females the palm of gnathopod 2 is evenly convex. The pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material Examined.—Syntypes, 32 juveniles, off Fairlie Perch, Cumbrae, Scotland, muddy sand at 36 m depth, February 1889 (BM(NH): catalogue no. BM 1928:12.1:2727-36).

Other Material Examined.—(45 adult males, 177 adult females, 146 juveniles) SCOTLAND: 6 adult males, 23 adult females, 42 juveniles, Loch Riddon, Argyll, and Cumbrae, month of collection unknown (BM(NH): catalogue nos. 1911.11.8: 21496-515; 1984:594:14). WALES: 3 adult males, 4 adult females, Colwyn Bay and Menai Strait, month of collection unknown (BM(NH): catalogue no. 1925.9.8: 1589–1591). IRELAND: 4 adult males, 3 adult females, Galway Bay, August (BM(NH): catalogue nos. 1984:255:4; 1984:256:2). ENGLAND: 32 adult males, 145 adult females, 104 juveniles, Plymouth, month of collection unknown (BM(NH): catalogue nos. 1911.11.8: 21476-495; 1911.11.8: 21516-523). FRANCE: 2 adult females, Baie de Quiberon and Portrieux, June (MNHN: catalogue nos. AM 2792, 2793).

Remarks.—Although Stebbing and Robertson (1891) figured an adult male and female, these could not be located at the British Museum (Natural History) (J.

Ellis, pers. comm.). *Microjassa cumbrensis* may be unique in having 8 spines on the maxilla 1 outer plate, rather than 9. However too few mouthparts could be examined to determine whether this is a constant number. Juveniles and females are similar to *M. litotes* and *M. barnardi* in uropod 3 cuspation. Unlike *M. litotes,* the anterodistal margin of the carpus of both gnathopods 1 and 2 (both sexes) is not setose. The second gnathopod of the male is distinctive in the pronounced hinge tooth which is midway between dactyl and thumb or close to the dactyl hinge. Unlike *M. litotes*, neither the basis nor the propodus is anteriorly spinose. The development sequence in *M. cumbrensis* is toward lengthening of the thumb; in *M. litotes* it is toward loss of any palmar definition.

Microjassa cumbrensis is superficially similar to *M. floridensis* in the appearance of the male's second gnathopod. However *M. floridensis* differs in the following respects: gnathopod 1, palm of the propodus more abruptly angled at the defining spines; gnathopod 2, propodus, anterior junction of the dactyl with a group of setae which are nearly as long as the dactyl itself, palm with a single bifid hinge tooth rather than 2 to 3 sequential teeth, dactyl shorter, without protuberance or sinuosity and with only a few short setae; coxa 3, ventral margin straight, posterior margin concave, only slightly narrower than coxa 4; uropod 1 without a peduncular process; uropod 3, outer ramus with 3–4 cusps; telson without cusps.

Krapp-Schickel and Schiecke (1974) suggest that *Jassa falcatiformis* is a hyperadult of *M. cumbrensis*. I agree and propose the synonymy herein.

Nagata (1965) mentioned the presence of *M. cumbrensis* in the Seto Inland Sea, Japan, but did not provide supportive documentation. The location of these specimens is unknown (A. Hirayama, pers. comm.). Since *M. cumbrensis* is unknown outside of northeastern Atlantic waters, it is more likely that Nagata's material is a Pacific species of *Microjassa, Jassa,* or *Ischyrocerus.*

Ischyrocerus? sp. of Ledoyer (1979), a male from Tulear, Madagascar, is similar to *M. cumbrensis,* but differs in the following respects: gnathopod 1, basis with one long anteromedial seta; gnathopod 2, basis, anterior flange abruptly narrowed dorsally, carpus as deep as the propodus at proximity, posterior lobe with one setal group; propodus, palm abruptly narrowed dorsally, carpus as deep as the propodus at proximity, posterior lobe with one setal group; propodus, palm with two sequential hinge teeth and two opposite defining teeth, the lateral half the length of the medial, neither with a spine at the tip, defining teeth short (longest tooth : propodus, L:W = 0.27). The absence of the defining spine on the gnathopod 2 would suggest that the specimen is a late instar and that, therefore, the defining teeth will not approach the length of the longest thumb of *M. cumbrensis*. Whether this specimen is a species of *Microjassa* cannot be determined with certainty because the specimen is lacking antennae and coxa 4 and coxa 5, appendages which provide diagnostic characters for the genus.

Distribution.—Confirmed: Loch Fyne, Scotland, to Baie de Quiberon, France, at 6–36 m depth in *Lithothamnion* and from dredges over muddy and gravelly sand, high salinity.

Unconfirmed (in the literature): Gulf of Marseilles, France (Bellan-Santini and Ledoyer, 1973); Sicily, Naples, Capri and Dalmatia, Italy, 35–40 m, from calcareous algae, in rocky crevices and from sandy sediment (Krapp-Schickel and Schieke, 1974); Strait of Bosporus, Turkey (Sowinsky, 1898); Tunisia (Myers, 1989b); Belfast Lough, Ireland (Parker, 1984).

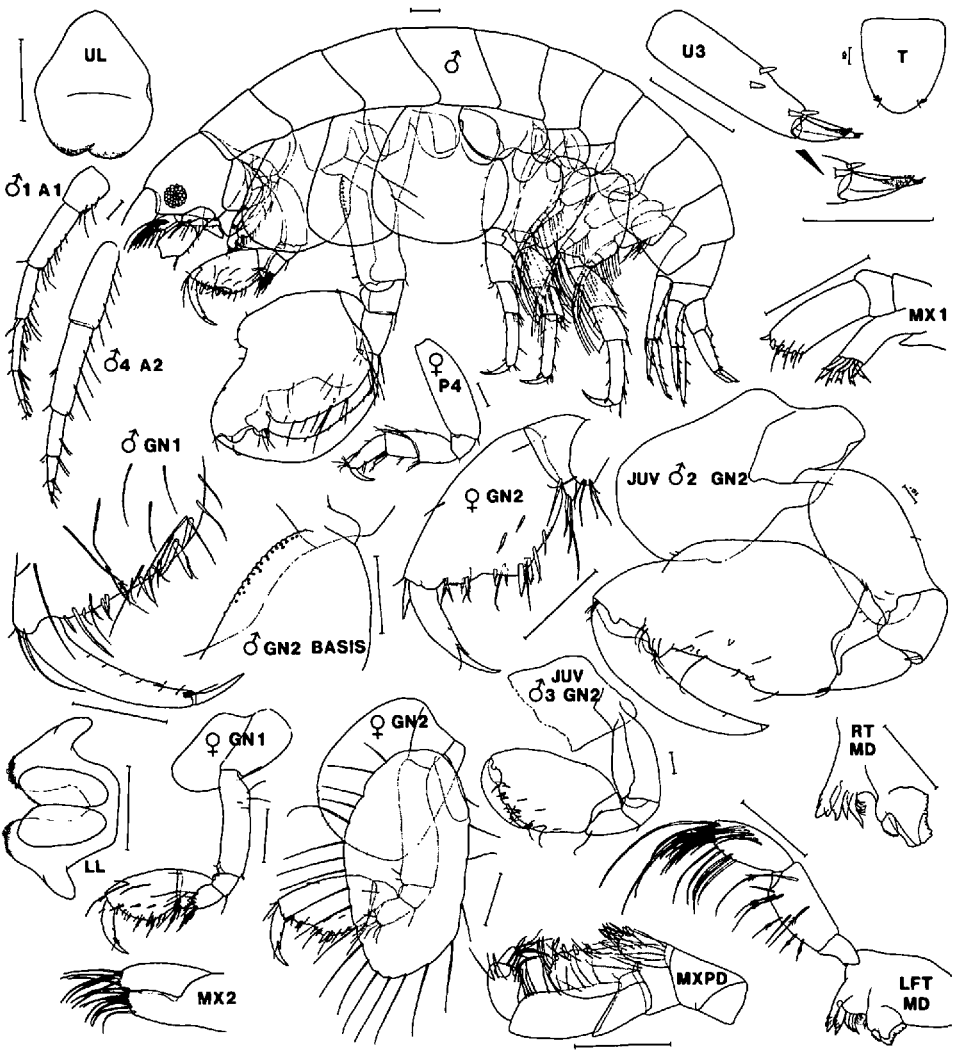


Figure 7. *Microjassa litotes* J. L. Barnard. Male, holotype, 2.8 mm; adult female, paratype, 2.0 mm; male 4. 2.5 mm (these designated 3.0, 2.5, and 2.5 mm respectively by J. L. Barnard, 1954); Cabrillo Beach, San Pedro, California, 28 April 1950. Male 1, 2.5 mm, Bamfield Marine Station, Barkley Sound, Vancouver Island, British Columbia, 24 June 1976. Juvenile male 2, 2.5 mm, from J. L. Barnard (1954). Note growth stages in the male gnathopod 2 and nodulations on the anterior margin of the basis. Lateral views: whole body, uropod 3, upper lip, and left mandible; dorsal view: telson; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm unless indicated otherwise.

Microjassa litotes J. L. Barnard
Figure 7

Microjassa litotes J. L. Barnard, 1954, 127; 1969a, 163; 1971, 17.
Ischyrocerus litotes: J. L. Barnard, 1962, 53; 1964, 226; 1966, 21; J. L. Barnard and G. S. Karaman, 1991, 201.

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 10–14 cusps. Pereiopods 3 and 4, carpus 40–50% overlapped by

merus. Gnathopod 1, basis not anterodistally spinose. Adult male gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face for stridulation; propodus without thumb, defining spine minute, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm shallowly excavate, marked by change in angle at position of defining spines.

Description.—ADULT MALE. (Redescription of holotype.) Length 2.8 mm. Antennae 1 and 2 absent (paratype, male, 2.5 mm, antenna 1 : antenna 2, L = 0.83; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles). Mandibular palp, article 3, W:L = 0.50. Pereiopods 1–4, basis, posteromedial margin with up to 2 setae. Gnathopod 1, coxa : coxa 2, L = 0.46; basis, anterior margin not spinose; carpus, anterodistal margin with 1 seta, posterior lobe : anterior margin, L = 0.44; propodus, palm not defined by change in angle; dactyl with 2 cusps. Gnathopod 2, coxa without stridulation ridges, ventral margin broadly convex, posterior margin slightly sinuous; basis insertion dorsal to mid-point of coxa; basis, lateral flange with few slender spines distally, tapering moderately abruptly at junction with coxa, without stridulation ridges, but with minute nodules between lateral and medial flanges; carpus : propodus, L = 0.25; anterodistal margin with 1 setal group, posterior lobe with 1 setal group; propodus, anterior margin convex, with setose protrusion and row of short, slender spines, setae at dactyl hinge short, less than half length of dactyl, palm convex and weakly setose, hinge teeth opposite, without thumb or central tooth; dactyl : propodus, L = 0.92, not posteroproximally crenulate, with 1 minute posteroproximal protuberance, inner marginal setae : dactyl, L:W = 0.13, outer margin without row of short setae. Pereiopod 3, coxa : coxa 4, L = 0.99, coxa 3, medial face finely crenulated; carpus 0.42 overlapped by merus. Pereiopod 5, coxa : coxa 4, L = 0.24. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 6 spines, posteroventral spinous process : peduncle, L = 0.25. Uropod 3, peduncle with 2 medial and 2 terminal spines, outer ramus terminating in 10 cusps and 2 setae, but without recurved spine. Telson with erect seta, short setae, and 2 cusps at each mid-dorsal apex.

CONDITION. Without antennae 1 and 2.

ADULT FEMALE. (Description of paratype.) Length 2.0 mm. Gnathopod 1, coxa : coxa 2, L = 0.55. Gnathopod 2, coxa, ventral margin broadly convex, posterior margin slightly sinuous; basis, anterodistal margin with 2 setae, without nodules, tapering gradually to junction of coxa; carpus : propodus, L = 0.29, propodus and dactyl similar in shape to and only slightly larger than propodus of gnathopod 1, palm slightly excavate, marked by change in angle at position of defining spines. Pereiopod 3, coxa : coxa 4, W = 0.75. Other character states as in male.

CONDITION. Ovigerous, without antennae or pereiopods 5–7. In ovigerous female, 2.0 mm from Bamfield Marine Station, Barkley Sound, Vancouver Is., B.C., antenna 1 : antenna 2, L = 0.83; antenna 2 peduncle setae longer than peduncle width, flagellum 3 articles.

VARIATION. Length: male up to 3.5 mm, female up to 2.5 mm. Earliest recognizable males differ from later instars in the following respects: gnathopod 1, coxa : coxa 2, L = 0.69 in two males, 2.5 mm, L = 0.61 in one male, 2.8 mm; dactyl with 1–4 cusps. Gnathopod 2, basis flange not abruptly narrowed dorsally; carpus, anterior and posterior margins with 1–2 setal groups; propodus, anterior margin without setose protrusion, spines fewer and seta-like, palm concave with abrupt change in angle at the location of the defining spine, one, rarely two defining spines; hinge tooth absent; defining angle and spine progressively proximal to carpus at later instars, eventually disappearing and palm transforming from

concave to convex; dactyl, earlier instars, reaching to the palmar defining spine; later instars extending to the full length of propodus. Other variation that may occur in either sex is: pereiopods 1–4, basis, posterior margin without setae. Gnathopod 1, carpus with or without anterodistal seta. Pereiopods 3 and 4, carpus overlapped ¼–⅓ by the merus. Pereiopod 5, coxa deeper in relation to coxa 4 (coxa 5:4, L = 0.53–0.56 in 3 juveniles, 2.5–2.8 mm). Uropod 1, peduncle with 5–8 spines; uropod 3, peduncle with 4–5 spines, outer ramus with 10–14 cusps. In early instar females the palm of gnathopod 2 is convex, and the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material Examined.—Holotype, male, Cabrillo Beach, outer harbor (Los Angeles harbor), San Pedro, California, from a wooden settling block submerged for 28 days, 28 April 1950, J. L. Barnard, collector (AHF(NHMLAC): catalogue no. AHF-509, station no. L-2-550). Paratypes, Los Angeles harbor, 1 female, 28 April 1950 (station no. L-2-550); 1 male, May, 1950 (station no. L-3-550); 1 male, May, 1950 (station no. M-2-550); 5 males, 2 females, 1 unsexable juvenile, May 1950 (station no. M-3-550); 2 males, 3 females, April 1950 (station no. N-3-450).

Other Material Examined.—Identified with confidence as *M. litotes* because large males were present in each collection (14 males, 31 females, 5 unsexable juveniles). ALASKA: 2 males, 1 female, 3 unsexable juveniles, Torch Bay, Glacier Bay National Monument 58°19.8'N, 136°46.3'W, 7.6 m depth (CMN: accession and station nos. IZ1987-112; IZ1989-066, 89.2.21). BRITISH COLUMBIA: 2 males, 2 females, 2 unsexable juveniles, Vancouver Island, Barkley Sound, June, July (CMN: accession and station nos. 1976-157, B1; 1976-163). CALIFORNIA: 10 males and 27 females, Monterey submarine canyon head to Los Angeles, November, February, April, May (AHF(NHMLAC): *Velero IV* station 4844; CMN: accession no. IZ1990-070).

Specimens indistinguishable from *M. barnardi* and *M. bousfieldi* due to the absence of large males (62 females, 11 unsexable juveniles). BRITISH COLUMBIA: 13 females, 5 unsexable juveniles, Vancouver Island, Barkley Sound to Victoria; mainland, Ocean Falls to Vancouver harbour; January, June, July, August, September, November, December (BCPM: catalogue no. 68 66/3/1-3; CMN: accession and station nos. 1969-319; 1970-152, P710; 1975-241; 1976-157, B7; 1976-163; 1977-329, E5; 1979-191, 28B-022; Trawl #1); WASHINGTON: 5 females, Mukkaw Bay, July (CMN: accession and station no. 1966-211, W40). CALIFORNIA: 44 females, 6 unsexable juveniles, Point Loma to Pinos Point, February, March, April, May, June, July, August, September, November, December (AHF(NHMLAC): *Velero IV* station nos. 4330; 4719; 4785; 4820; 4850; 4863; 4924; 4928; 4939; 5003; 5030; 5617; 5820; 5828; 5840; 5971; 6103; 6105; 6432; J. L. Barnard stations L-2-550, Barnard 3, 26, 30; USNM 182/053) (CMN: catalogue nos. NMCC1989-0726 and 0819 to 0827 and NMCC1993-0031, 0032). Females ovigerous in all collecting months.

Remarks.—Color in life: eyes red. Body cuticle shiny, basally white or clear, banded at each segment with brown. Breadth of banding and intensity of pigmentation is variable.

From all species but *M. cumbrensis, M. barnardi,* and *M. bousfieldi,* any age and either sex of *M. litotes* is distinguishable by the presence of 10–14 minute cusps on the dorso-distal surface of the uropod 3 outer ramus coincident with lack of the dorsally recurved terminal spine. The second gnathopod of large males is highly characteristic and distinguishes the species from all other species of the genus. Small males are separable from *M. cumbrensis* by the second gnathopod palm being more excavate; however this difference is not apparent in small females, where the palm is convex in both. In males the second gnathopod of *Microjassa litotes* is very similar to that of *M. barnardi* and *M. bousfieldi* until later instars are reached. Small males of these species cannot be told apart. In large males the second gnathopods are distinctive. In *M. barnardi* and *M. bousfieldi,* the basis of the gnathopod is inserted on the coxa more distally than in *M. litotes,* the flange on the basis lacks spines (but may possess nodules) and more evenly merges proximally, the carpus is larger, the propodus lacks the protuberance of *M. litotes,* the palm of the propodus is concave (rather than convex as in *M. litotes*), and the dactyl possesses a few to many long setae along the inner margin (setae are minute in *M. litotes*). Only the males illustrated by J. L. Barnard

(1962) for *Velero IV* stations 4844 and 5030 are retained herein as *M. litotes*; other records in the literature will now require confirmation. As for small males, the females of *M. litotes* are difficult to distinguish from *M. barnardi*. There are differences in the shapes of the coxae but these are evident only in large specimens.

Microjassa litotes has undergone re-classification at the generic level. J. L. Barnard (1962) transferred it to *Ischyrocerus* on the basis of coxa 5 being significantly longer than coxa 6. J. L. Barnard (1966) subsequently questioned this move, because coxa 1 was short in contrast to other members of *Ischyrocerus*. J. L. Barnard (1969b) returned the species to *Microjassa* without comment, but J. L. Barnard and G. S. Karaman (1991) transferred *M. litotes* to *Ischyrocerus* once more, again without comment.

J. L. Barnard (1962) confused *M. litotes* with, at that time, the unrecognized *M. barnardi*. The male "*Ischyrocerus litotes*" in Fig. 23A–D is actually *M. barnardi*, and the male "*I. litotes*" in Fig. 24 is *M. litotes*. It is unlikely that J. L. Barnard confused the Baja California specimens of "*I. litotes*" with *M. macrocoxa* because these species are quite different and he was aware of these differences at the time of writing J. L. Barnard (1963). Unexamined specimens of "*M. litotes*" have also been recorded from the stipe and fronds of the kelp *Macrocystis pyrifera* (Linnaeus, 1771) C. Agardh, 1820 at Santa Catalina Island, California (Coyer, 1984). The types were collected from settling blocks immersed 28 days inside and outside Los Angeles Harbor (J. L. Barnard, 1954).

Distribution.—Confirmed by presence of large (presumably adult) males: Torch Bay, Alaska to Los Angeles Harbor, Calif. High salinity exposed or semi-exposed coasts, subtidally to 17 m. Amongst small algae on algal holdfasts.

Unconfirmed due to lack of large males: Ocean Falls, British Columbia to Pinos Point, California at depths of up to 154 m.

Unconfirmed (in the literature): south to Bahía de Cristóbal, Baja California, 1–157 m (J. L. Barnard, 1966).

Unconfirmed reports of *M. litotes* may prove to be *M. litotes, M. barnardi,* or *M. bousfieldi.*

Microjassa barnardi new species
Figure 8

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 7–14 cusps. Pereiopods 3 and 4, carpus 30–35% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face for stridulation; propodus without thumb but with broad expansion at palmar definition, defining spine minute, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm shallowly excavate, marked by change in angle at position of defining spines.

Description.—ADULT MALE. Holotype: Length 2.5 mm. Antennae 1 and 2 absent; antenna 2, paratype, male, 1.8 mm, peduncle setae longer than peduncle width; flagellum 3 articles. Mandibular palp article 3, W:L = 0.59. Pereiopods 1–4, basis, posteromedial margin with up to 3 setae. Gnathopod 1, coxa:coxa 2, L = 0.51; basis, anterior margin not spinose; carpus, anterodistal margin with 1 seta, posterior lobe:anterior margin, L = 0.41; propodus, palm slightly concave, defined by change of angle; dactyl with 1 cusp. Gnathopod 2, coxa without stridulation ridges, ventral margin wide and convex, posterior margin straight; basis inserted

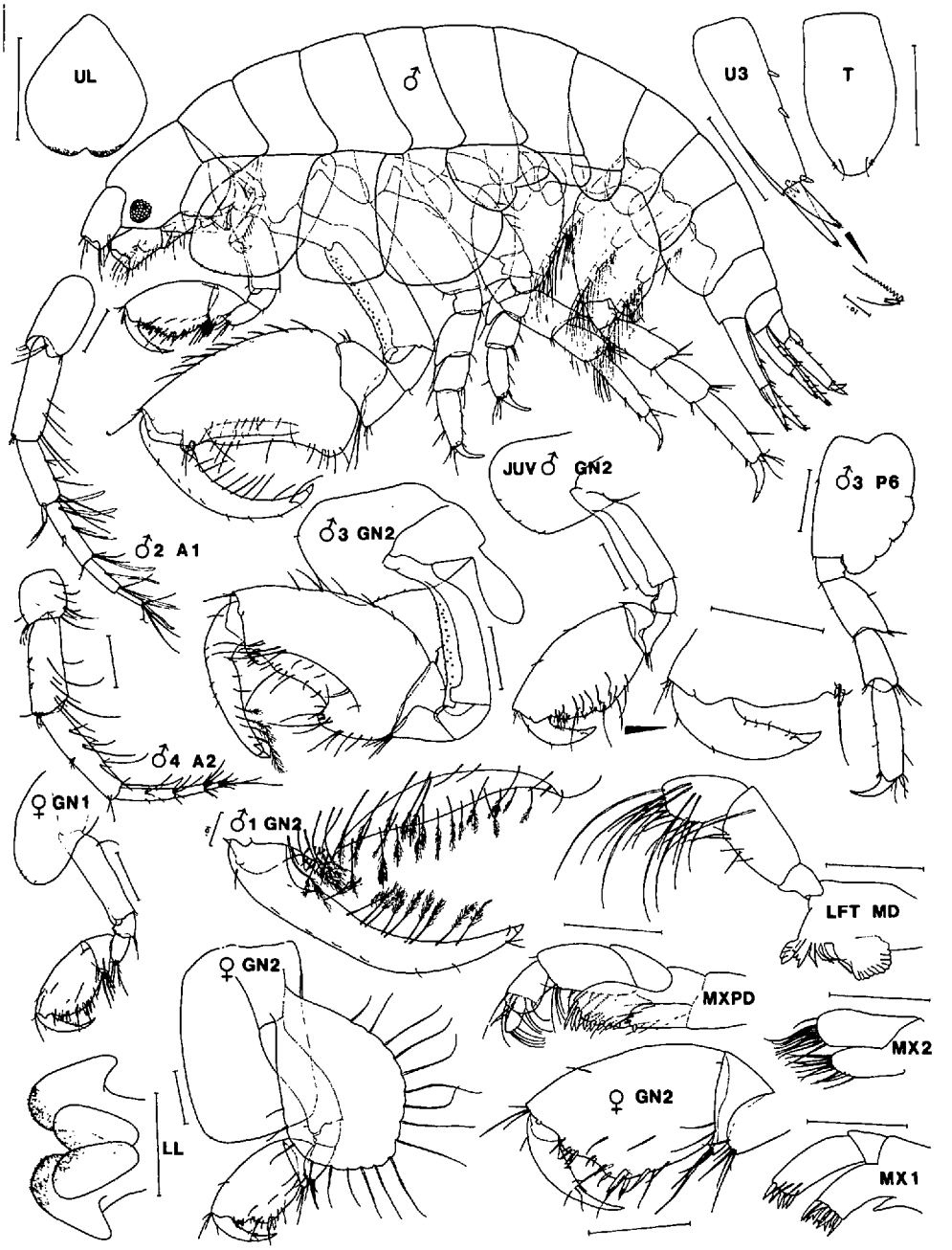


Figure 8. *Microjassa barnardi* n. sp. Male, holotype, 2.5 mm; adult female, allotype, 2.0 mm; paratypes, male 2, 2.1 mm; male 3, 1.9 mm; male 4, 1.8 mm; juvenile male, 1.7 mm; Cayucos, California, 1 July 1961. Male 1, 2.8 mm, Oregon, off the Columbia River mouth. Lateral views: whole body, upper lip, uropod 3, pereiopod 6, maxilla 1, mandible, and female gnathopod 1; dorsal view: telson; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm unless indicated otherwise.

at half depth of coxa, basis not spinose, but with minute nodules between lateral and medial flanges, lateral flange moderately abruptly narrowed dorsally, without stridulation ridges; carpus : propodus, L = 0.26, anterior margin with few spines and posterior lobe with few setae; propodus, anterior margin convex, not sinuous, without setose protrusion but with row of spine-like setae, setae at dactyl hinge short, less than half length of dactyl, palm concave and slightly sinuous and weakly setose, with 1 hinge tooth and broad expansion at palmar definition, but without distinct defining tooth or thumb and without defining spine; dactyl : propodus, L = 0.88, inner margin with shallow protuberance proximally, inner marginal setae : dactyl, L:W = 1.75, outer margin with row of short setae. Pereiopod 3, coxa : coxa 4, L = 1.02, coxa 3, medial face finely crenulated; carpus 0.34 overlapped by merus. Pereiopod 5, coxa : coxa 4, L = 0.53. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 4 spines, posteroventral spinous process : peduncle, L = 0.35. Uropod 3, peduncle with 2 spines medially and 2 spines distally, outer ramus terminating in 14 cusps, with 2 terminal setae but without recurved spine. Telson with erect seta and 2 cusps at each apex.

CONDITION. Without antennae or pereiopod 6.

ADULT FEMALE. Allotype: Length 2.0 mm. Antenna 1 : antenna 2, L = 0.92; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles. Pereiopods 1–4, basis, posteromedial margin with 0–1 setae. Gnathopod 1, coxa : coxa 2, L = 0.69. Gnathopod 2, coxa, ventral margin straight, posterior margin straight; basis inserted dorsal to mid-point of coxa, without nodules, lateral flange tapering gradually to coxal junction; carpus : propodus, L = 0.29, anteriodistal margin with 1 short seta, posterior lobe with 3 setal groups; propodus and dactyl similar to those of gnathopod 1 but palm shallowly excavate and defined by abrupt change of angle. Pereiopod 4, coxa damaged. Uropod 1, peduncle with 5 spines. Uropod 3, peduncle with 1 medial and 2 distal spines; outer ramus with 13 terminal cusps. Other character states as in male.

CONDITION. Brooding young, without pereiopods 5–7; pereiopod 4, right coxa damaged.

VARIATION. Length: male up to 2.5 mm, female up to 2.1 mm. Earliest recognizable males differ from older males in the following respects: gnathopod 2, basis inserted more proximally to the body, anterior flange without nodules; propodus, anterior margin with fewer spine-like setae and setae slenderer, palm less excavate, palmar defining spine present, palmar and dactylar setae simple or plumose; in very small individuals dactyl without long marginal setae. In either sex the anterodistal seta on the carpus of gnathopod 1 may be present or absent. Uropod 3, peduncle with 1–3 lateral and 0–1 medial spines; outer ramus with 7–14 terminal cusps (fewer in smaller than large individuals), lateral setae present or absent. In early instar females the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material.—Holotype, male, Cayucos, California, from rock surfaces in the pelvetiid zone, intertidal, 1 July 1961, J. L. Barnard (USNM: catalogue no. 266420, station no. 38-C-4). Allotype, female, same locality (USNM, catalogue no. 266421). Paratypes, 5 males, 7 females, and 1 unsexable juvenile, same locality (USNM, catalogue no. 266422).

Other Material.—(9 males, 32 females, 6 unsexable juveniles) OREGON: 7 males, 17 females, Sunset Bay, Coos County and off the Columbia River mouth (CMN: catalogue no. NMCC1989-0809, station no. O6-2; USNM: station nos. AD 85, Ore 65). CALIFORNIA: 2 males, 15 females, 6 unsexable juveniles, Cayucos to San Mateo Point, December, February, July (AHF(NHMLAC): *Velero IV* station nos. 4768; 4777; 4781; 4785; 4869; 4910; 5789; 5613; USNM: catalogue no. 127593). Females ovigerous December.

Remarks.—Microjassa barnardi (both sexes, juveniles as well) can be distin-

guished from all other species of the genus except *M. litotes, M. bousfieldi,* and *M. cumbrensis* by possessing a large number of minute cusps and lacking a terminal spine on the uropod 3 outer ramus. It can also be readily differentiated from *M. macrocoxa, M. floridensis,* and *M. tetradonta* by possessing a peduncular spinous process on uropod 1. Considering later instar males alone, the gnathopod 1 coxa of *M. barnardi* is not anterodistally produced as in *M. cumbrensis,* the male gnathopod 2 palm lacks long teeth, the anterior margin of the carpus and propodus bear long spine-like setae, the carpus is wider, the basis is inserted more distally on the coxa, the uropod 1 peduncular spinous process is somewhat longer, and the uropod 3 outer ramus possesses more cusps (12–14 versus 7–11 in large males). The females differ by the shape of the second gnathopod palm: in *M. cumbrensis* it is not marked by an abrupt change in angle at the position of the defining spines while in *M. barnardi* it is. *Microjassa cumbrensis* is also only known from the northeastern Atlantic and Mediterranean Sea, while *M. barnardi* is only known from the Pacific coast of North America.

Small males of *M. barnardi* with relatively female-like second gnathopods are not separable from *M. litotes* and *M. bousfieldi.* Large males of *Microjassa barnardi* differ from *M. litotes* in second gnathopod structure in the following respects: basis inserted centrally on the coxa (as opposed to proximally in *M. litotes*); basis flange without spines; carpus larger, anterior margin of it and propodus with long spine-like setae; propodus without an anterior protuberance, palm concave (rather than convex); dactyl with long setae along the inner margin. Although *M. barnardi* and *M. bousfieldi* both possess long setae on the dactyl of the second gnathopod (these setae may be sparse in smaller specimens), *M. barnardi* is distinguished by also bearing a row of spine-like setae along the anterior of the propodus, a feature that *M. bousfieldi* lacks. In addition, the palms of the male's first gnathopod and the female's second gnathopod are more transverse in appearance in *M. barnardi* than in *M. bousfieldi.* The male illustrated by J. L. Barnard (1962) in fig. 23A–D is actually *M. barnardi. Microjassa barnardi* was termed "*Microjassa* sp. A" in Conlan (1988).

Etymology.—In honour of the late Dr. J. L. Barnard of the Smithsonian Institution, who collected and generously lent much of the material for this study.

Distribution.—Confirmed by the presence of large males: off the Columbia River, Oregon to San Mateo Point, California. From dredges of green and grey silts, mud and sand sediments at 0.5–52 m depth. Also collected from *Odonthalia floccosa* (Esper) Falkenberg and *Microcladia coulteri* Harvey on the exposed coast of Oregon at 0.5 m below low water. Since females cannot be distinguished from females of *M. litotes, M. barnardi* may in fact range more widely, at least within the range given for *M. litotes.*

Microjassa bousfieldi new species
Figure 9

Diagnosis.—Uropod 1 with peduncular spinous process. Uropod 3, outer ramus terminating in 16 cusps. Pereiopods 3 and 4, carpus 25–40% overlapped by merus. Gnathopod 1, basis not anterodistally spinose. Adult male gnathopod 2, basis with small nodules anteriorly and coxa 3 with fine crenulations on medial face for stridulation; propodus without thumb but with marked change in angle at palmar definition, defining spine minute or absent, anterior margin without spine-like setae. Adult female, gnathopod 2 propodus, palm convex.

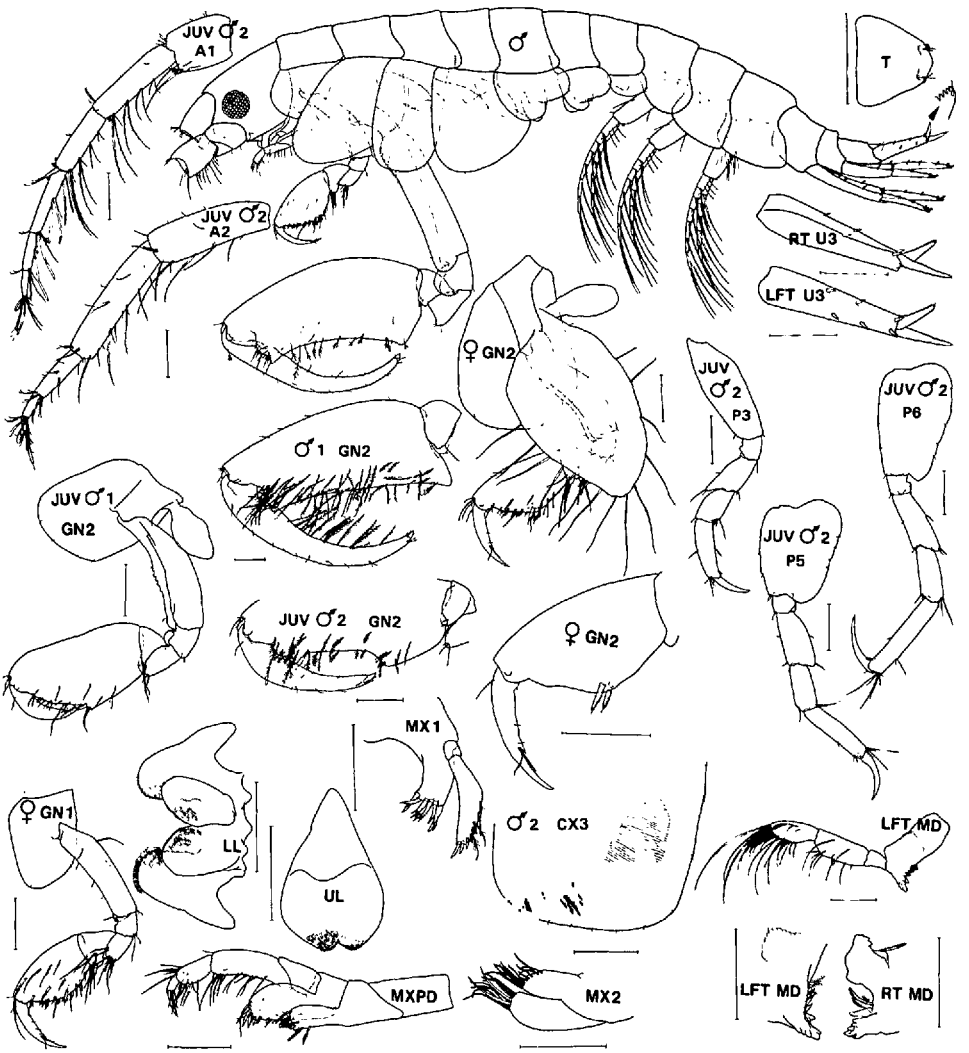


Figure 9. *Microjassa bousfieldi* n. sp. Male, holotype, 2.3 mm; juvenile male 1, paratype, 1.4 mm; adult female, allotype, 2.0 mm; off Purisima Point, California, Cruise 1-3, station R-4, replicate 1, May 1987. Male 1, paratype, 3.0 mm, and male 2, paratype, 2.6 mm, off Purisima Point, California, Camp 1-3, station R-5, replicate 1. Juvenile male 2, 1.8 mm, off Purisima Point, California, Camp 2-3, station R-4, repicate 1. Note fine crenulations on the medial face of the male 2's coxa 3. Lateral views: whole body, juvenile male 2 antenna 2, left uropod 3, mouthparts, and maxilla 1; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm.

Description.—ADULT MALE. Holotype: Length 2.3 mm. (Paratype, male, 1.8 mm, antenna 1 : antenna 2, L = 0.92; antenna 2, peduncle setae longer than peduncle width; flagellum 3 articles.) Mandibular palp article 3, W:L = 0.31. (Paratype, male, 1.8 mm, pereiopods 1–4, basis, posteromedial margin without long setae.) Gnathopod 1, coxa : coxa 2, L = 0.55, basis, anterior margin not spinose; carpus, anterodistal margin with short seta, posterior lobe : anterior margin, L = 0.39; propodus, palm convex; dactyl with 3 cusps. Gnathopod 2, coxa without stridulation ridges, ventral margin wide and convex, posterior margin straight; basis

inserted at half depth of coxa, basis not spinose, but with minute nodules dorsally, lateral flange moderately abruptly narrowed dorsally, without stridulation ridges; carpus : propodus, L = 0.11, anterior margin without spines and posterior lobe with few setae; propodus, anterior margin convex, not sinuous, without setose protrusion or row of spine-like setae, setae at dactyl hinge short, less than half length of dactyl, palm shallowly concave and weakly setose, nearly full length of propodus, with 1 hinge tooth and single minute defining spine distal to palmar corner, but without thumb; dactyl : propodus, L = 0.86, inner margin with shallow protuberance proximally, inner marginal setae : dactyl, L:W = 0.50, outer margin with row of short setae. Pereiopod 3, coxa : coxa 4, L = 1.09, coxa 3, medial face finely crenulated; without pereiopods; carpus, female, allotype, 0.40 overlapped by merus. (Paratype, male, 1.8 mm, pereiopod 3, coxa, medial face finely crenulated; carpus 0.27 overlapped by merus.) Pereiopod 5, coxa : coxa 4, L = 0.46. Urosome 1 without pair of erect setae dorsally. Uropod 1, peduncle with 8 spines, posteroventral spinous process : peduncle, L = 0.34. Uropod 3, peduncle with 4 spines medially and 2 spines distally, outer ramus terminating in 16 minute cusps, with terminal seta but without recurved spine. Telson with erect seta and pair of cusps at each apex.

CONDITION. Without antennae or pereiopods 3–7.

ADULT FEMALE. Allotype: Length 2.0 mm. Without antennae. Pereiopods 1–4, basis, posteromedial margin with 0–3 setae. Gnathopod 1, coxa : coxa 2, L = 0.73. Gnathopod 2, coxa, ventral margin evenly convex, posterior margin straight; basis inserted at about centre of coxa, without nodules, lateral flange tapering gradually to coxal junction; carpus : propodus, L = 0.32, anterodistal margin without seta, posterior lobe with several setal groups; propodus and dactyl similar to those of gnathopod 1, palm convex, without abrupt change of angle. Pereiopod 4, coxa damaged. Other character states as in male.

CONDITION. Without antennae or pereiopods 5–7; right pereiopod 4, coxa damaged.

VARIATION. Length: male up to 3.1 mm, female to 2.7 mm. In the largest paratype, a 3.04 mm male, the nodules on the basis of the second gnathopod range along the full length of the anterior margin, the palm of the propodus is strongly concave and extends its full length, and the dactyl setae are longer than the width of the dactyl. Earliest recognizable males differ from larger males in the following respects: gnathopod 2, basis inserted more proximally to the body, anterior flange, nodules more central; propodus, palm half the length of the propodus, palm straight; dactylar setae 2–3 and minute. In either sex the uropod 3 peduncle may have 0–1 spines mid-dorsally and 1 spine distally. In early instar females the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material.—Holotype, male, off Purisima Point, California (34°43.0'N, 120°47.4'W), May 1987, 92 m depth, California Phase II Monitoring Program, Minerals Management Service, Pacific OCS Office, Santa Maria Basin Project, R. Kropp et al., collectors (USNM: catalogue no. 266399). Allotype, female, same locality (USNM: catalogue no. 266400, Cruise 1-3, station R-4, replicate 1). Paratypes, 1 female, 9 unsexable juveniles (USNM: catalogue no. 266401); 2 females, 2 unsexable juveniles, same location (CMN: catalogue no. NMCC1993-0002). Paratypes, 1 male (USNM: catalogue no. 266402); 1 male, 1 female, 1 unsexable juvenile (NHMLAC: catalogue no. LACM 87-421.1); 2 females, 2 unsexable juveniles, off Purisima Point, California (34°43.0'N, 120°47.4'W), January 1987, 92 m depth, California Phase II Monitoring Program, Minerals Management Service, Pacific OCS Office, Santa Maria Basin Project (SBMNH: catalogue no. 35645, Cruise 1-2, station R-4, repicate 1). Paratypes, 1 male, 1 female, 5 unsexable juveniles, same location (NHMLAC) (Camp 2-3, station R-4, replicate 1). Paratypes, 3 females, 9 unsexable juveniles (NHMLAC) and 2 males, 2 females (CMN, NMCC1994-0440), off Purisima Point, California (34°42.69'N, 120°50.83'W), 154 m depth (NHMLAC) (Camp 1-3, station R-5, replicate 1).

Other Material.—CALIFORNIA: 14 males, 26 females, 64 juveniles, off Pt. San Luis, Pt. Sal, and Purisima Pt., 90–161 m depth, R. Kropp et al., collectors (NHMLAC: California Phase II Monitoring Program, Minerals Management Service, Pacific OCS Office, Santa Maria Basin Project, stations R1, R2, R4, R5, R8, and PJ-7).

Remarks.—*Microjassa bousfieldi* is closest to *M. barnardi,* but can be distinguished by the convex palms of gnathopod 1 in the male and gnathopod 2 in the female, smaller amount of nodulation on the basis of the male's second gnathopod, and lack of spinose setae on the anterior margin of the propodus of the male's second gnathopod. Although the amount and length of dactyl setation is the same in large males of both species, other specimens of *M. bousfieldi* with still very elongate palms possess only a few, short setae while males of *M. barnardi* with short palm excavations still possess long dactylar setae. This suggests that the development of dactyl setation occurs only at large size in *M. bousfieldi* but at smaller size (i.e., earlier in the growth trajectory) in *M. barnardi.*

Considering non-sexually dimorphic characters, the third uropod outer ramus of *M. bousfieldi* resembles that of *M. barnardi,* which then serves to distinguish this species from other species of the genus except *M. litotes* and *M. cumbrensis. Microjassa bousfieldi* can be differentiated from *M. litotes* by the convex palms of the female's second gnathopod and the concave, rather than convex palm of the male's second gnathopod (but note the similarity between juveniles). Other northeastern Pacific species, *Microjassa macrocoxa* and *M. boreopacifica,* differ from *M. bousfieldi* in the different cusping of the third uropod outer ramus and different second gnathopod shape in both sexes.

Etymology.—In honour of Dr. E. L. Bousfield, Curator Emeritus of the Canadian Museum of Nature, who assisted in many aspects of this study.

Distribution.—Known from the Santa Maria Basin area of California only, from soft sediment at 90–161 m depth.

Neoischyrocerus new genus

Type Species.—*Microjassa claustris* J. L. Barnard.

Diagnosis.—Antenna 1, accessory flagellum 2 articles (second minute). Coxa 1 and especially coxa 5 more than half depth of coxae 2–4; coxa 4 not posteriorly excavate. Gnathopods 1 and 2 and pereiopods 5–7, face of dactyl serrated. Adult male without stridulating nodules or ridges on basis of gnathopod 2 and associated ridges on medial face of coxae 2 or 3.

Description.—Length up to 2.2 mm. Antenna 1, accessory flagellum 2 articles (second minute). Upper lip, ventral margin not indented. Mandibular palp, article 3 nearly as wide as long. Pereiopods 2–4, coxae, depth 1.25 or less the depth of body. Gnathopod 1, depth of coxa more than 0.6 depth of coxa 2. Pereiopod 4, coxa not posteriorly excavate. Pereiopod 5, coxa more than 0.6 depth of coxa 4. Gills slender (width about 0.25 length). Gnathopods 1 and 2 and pereiopods 5–7, face of dactyl serrated. Gnathopod 1, male, basis length 0.27–0.43 that of gnathopod 2 basis. Gnathopod 1, female, propodus wider than, and equal to or slightly larger than propodus of gnathopod 2. Gnathopod 2, female, palm of propodus evenly convex; brood plates moderately convex, setae hook-tipped. Gnathopod 2, male, basis inserted on distal half of coxa, without stridulation ridges or minute nodules, anterior marginal setae extending most of length of basis; dactyl with 2 protuberances, inner margin cusped, outer margin without row of short setae. Pereiopods 3 and 4, coxa without stridulation ridges or crenulations on

medial face; propodus, posterior margin spinose (less so in female and juvenile). Telson with strong spine and small seta at each apex but without cusps.

Distribution.—Known only from warm Pacific waters: southern California, Panama, Galapagos Islands, and Hawaiian Islands.

Remarks.—*Microjassa claustris* J. L. Barnard, 1969a, *M. chinipa* J. L. Barnard, 1979 and *Jassa lilipuna* J. L. Barnard, 1970 are herein transferred to *Neoischyrocerus*.

The type species for the genus *Ischyrocerus, I. anguipes* Krøyer, 1838, differs from all species of *Neoischyrocerus* in the following respects: body larger (up to 12 mm or more); upper lip, epistome narrowly acute; maxilla 1, inner plate setose; female gnathopod 1, propodus similar in shape to but narrower and smaller than the propodus of gnathopod 2; male gnathopod 2, propodus, palm not expanded into a small tooth or shallow protuberance proximal to the junction of the carpus; gnathopods 1 and 2 and pereiopods 5–7, lateral and medial faces of the dactyl not serrated (although there may be minute cusps on the anterior margin); urosome segment 2 with a pair of erect setae dorsally; uropod 3, peduncle, ventral surface setose, outer ramus with a terminal, dorsally recurved, basally immersed spine, inner ramus, terminal spine also dorsally recurved; female, brood plates broad, setae abundant.

Species of *Jassa* differ from *Neoischyrocerus* in the following respects: head lobe squared; mandibular palp, article 3 slenderer; maxilla 1, inner plate setose; female gnathopod 2 considerably larger than gnathopod 1, palm concave; male gnathopod 2, carpus much smaller, thumb defining the palm of the propodus much larger, developing only in the terminal instar, and distal of the defining spines (in *Neoischyrocerus* and *Microjassa,* the thumb develops at the origin of the defining spines, with these, if minute, being retained at the tip of the thumb; unlike *Jassa*, the thumb develops before the last instar and enlarges with growth); pereiopods 3 and 4, carpus at least 75% overlapped by the merus, propodus not posteriorly spinose; gnathopods 1 and 2 and pereiopods 5–7, dactyls not facially serrated; urosome 1 with dorsal pair of erect setae; uropods 1 and 2, terminal spines shorter; uropod 3, peduncle, ventral surface setose, outer ramus with 2 (typically) or 3 (rarely) cusps and a basally immersed, dorsally recurved spine; telson with nipple and slender spine at each side; female, brood plates broad, setae abundant.

Both *Jassa* and *Ischyrocerus* are cold temperate genera, while *Neoischyrocerus* is a warm water genus. *Ischyrocerus longimanus* (Haswell, 1879), *I. oahu, I. oahu armatus,* and *Jassa* sp. of Ledoyer (1978) resemble species of *Neoischyrocerus.* These species may require new taxonomic status, either within *Neoischyrocerus* or within a new genus.

Key to the World Species of *Neoischyrocerus*

1a. Gnathopod 2 larger than and different in appearance from gnathopod 1 (Figs. 10–13) (increasingly so with age). Pereiopods 2–5 without brood plates. Sternite 7 with pair of penial papillae ..... Male 2

1b. Gnathopod 2 hardly larger than gnathopod 1 (Figs. 10–13). Adult female, pereiopods 2–5 with setose brood plates which interleave to form egg carrying marsupium (smaller and non-setose in subadult, absent in juvenile). Sternite 7 without pair of penial papillae ..... Female and Unsexable Juvenile 4

Male

2a. Gnathopod 2, carpus not setose posteriorly; propodus with small proximal thumb which bears series of setae on posterior margin and two minute spines at tip; dactyl, inner (posterior)

margin with one protuberance proximally and series of long, evenly spaced setae. Hawaiian Islands ..... *N. lilipuna* (J. L. Barnard) (Fig. 10)

2b. Gnathopod 2, carpus setose posteriorly; propodus without thumb, palm defined only by change of angle, without series of evenly spaced setae or defining spines at angle; dactyl, inner margin with 2 proximal protuberances, setae, if present, minute (Figs. 11, 13) 3

3a. Gnathopod 2, propodus, dactyl little more than half length of palm. Pereiopods 3 and 4, coxae, ventral margins evenly convex. California ..... *N. claustris* (J. L. Barnard) (Figs. 11, 12)

3b. Gnathopod 2, propodus, dactyl ¾ or more length of palm. Pereiopods 3 and 4, coxae, ventral margins shallowly excavate. Panama, Galapagos Islands ... *N. chinipa* (J. L. Barnard) (Fig. 13)

Female and Unsexable Juvenile

4a. Gnathopods 1 and 2 and pereiopods 5–7, dactyl with single comb of fine striae. Pereiopods 3 and 4, propodus, posterior margin with two strong spines. Hawaiian Islands ..... *N. lilipuna* (J. L. Barnard) (Fig. 10)

4b. Gnathopods 1 and 2, pereiopods 5–7, dactyl with 2 combs of fine striae. Pereiopods 3 and 4, propodus, posterior marginal spines slender, seta-like (Figs. 12, 13) 5

5a. California. Morphologically indistinguishable from *N. chinipa*, requiring presence of males for identification ..... *N. claustris* (J. L. Barnard) (Figs. 11, 12)

5b. Panama, Galapagos Islands. Morphologically indistinguishable from *N. claustris*, requiring presence of males for identification ..... *N. chinipa* (J. L. Barnard) (Fig. 13)

Neoischyrocerus lilipuna (J. L. Barnard), new combination
Figure 10

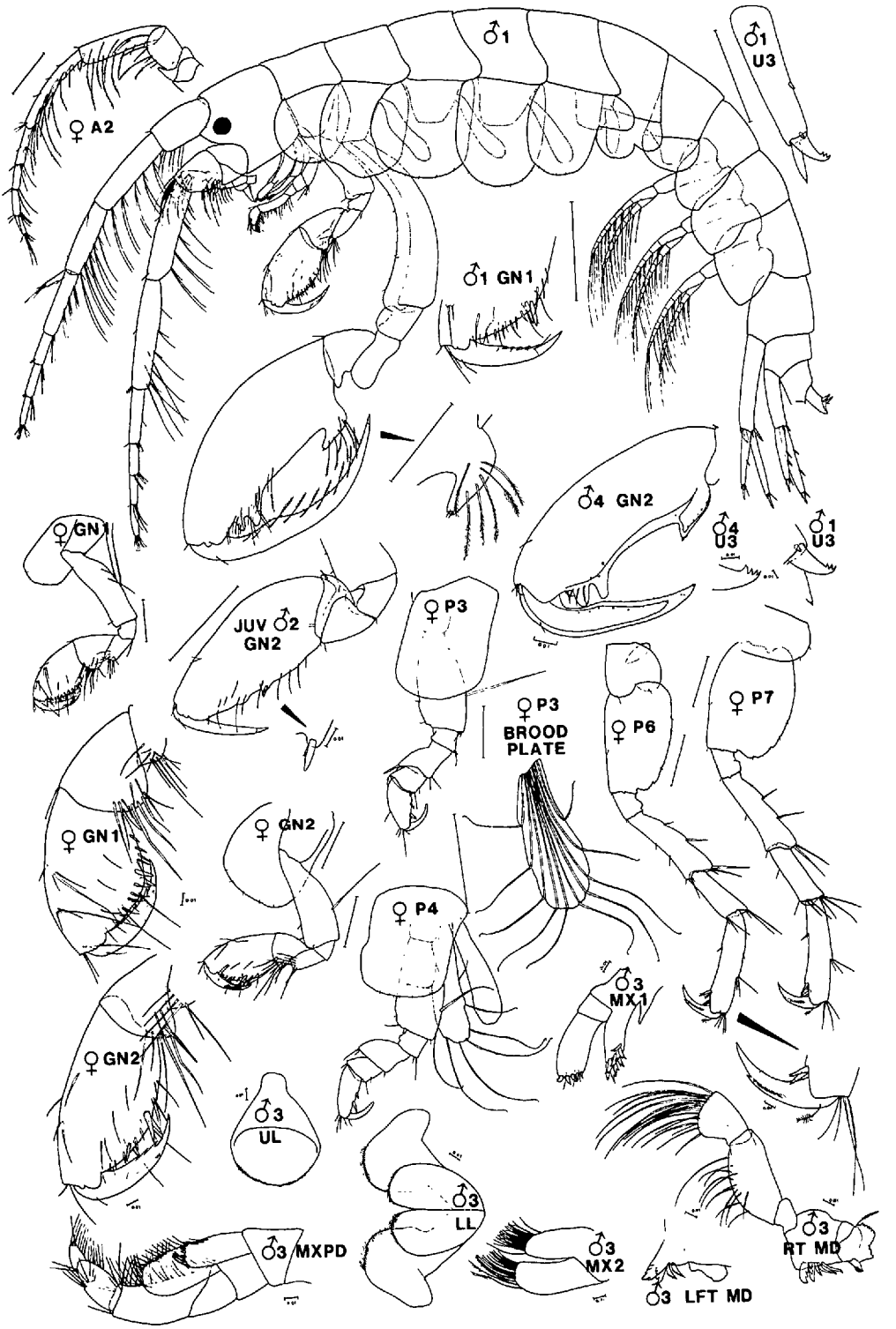
Jassa lilipuna J. L. Barnard, 1970, 198; 1971, 99.

Diagnosis.—Gnathopods and pereiopods 5–7, dactyl with single comb of striae. Pereiopods 3 and 4, ventral margins of coxae not excavate; posterior margin of propodus with 2 strong spines. Adult male gnathopod 2, propodus with small thumb originating proximally, thumb with two minute spines at tip; dactyl maximally full length of palm, inner margin with one protuberance proximally and series of long, evenly spaced setae.

Description.—Adult Male. (Redescription of holotype.) Length 1.9 mm. Gnathopod 1, coxa rounded, anterior margin not distally produced. Coxa 1 : coxa 2, L = 0.89. Coxa 2 : coxa 3, L = 0.84. Gnathopod 1 : gnathopod 2, L = 0.41. Gnathopod 2, coxa, ventral margin excavate, posterior margin straight; basis, anterolateral flange, anterior margin with row of minute setae which do not grade into spines distally; ischium without setae or spines; carpus, anterior margin with 1 distal seta, posterior lobe without setae; propodus, palm weakly setose, with 2 sequential hinge teeth, palmar thumb originating proximally, anteriorly directed, not minutely serrated, with row of setae on posterior margin and 2 minute spines at tip; dactyl as long as propodus, inner margin with 1 protuberance proximally, inner marginal setae as long as dactyl width. Pereiopods 3 and 4 lacking, coxae, ventral margins convex. Pereiopod 5, coxa, posterior lobe not produced ventrally. Epimera 1–3, posterodistal margin without notch and minute seta. Uropods 1 and 2, peduncle without proximal spines. Uropod 3, peduncle with 1 proximal and 1 distal spine; outer ramus with 3 terminal cusps.

→

Figure 10. *Neoischyrocerus lilipuna* (J. L. Barnard). Male, holotype, 1.9 mm, Waikiki, Oahu, Hawaiian Islands, 11 March 1964. Adult female, 1.5 mm; juvenile male 2, 1.5 mm; male 3, 1.8 mm; male 4, 1.9 mm; Fee #1, Waikiki, Oahu, Hawaiian Islands, 25 April 1967. Note the differing defining spine structure in the juvenile male 2 and the apparently more differentiated palmar defining tooth on the internal cuticle of the male 4 (some setae not shown; origins indicated by small circles). Lateral views: whole body, uropod 3, pereiopods 3, 4, 6, 7, and left mandible; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm unless indicated otherwise.


♂1
♂1 U3
♀ A2
♂1 GN1
♂4 GN2
♂4 U3
♂1 U3
♀ GN1
JUV ♂2 GN2
♀ P3
♀ P3 BROOD PLATE
♀ P6
♀ P7
♀ GN1
♀ GN2
♀ P4
♂3 MX1
♀ GN2
♂3 UL
♂3 LL
♂3 MXPD
♂3 MX2
♂3 RT MD
♂3 LFT MD

CONDITION. Without pereiopods 3–7.

ADULT FEMALE. Not type. Female, Waikiki, Oahu, Hawaiian Islands, wash of *Ulva lactuca* and substrate, intertidal, 25 April 1967, J. Fee, collector (BPBM: station no. Fee #1). Length 1.6 mm. Antenna 2 as setose as antenna 1. Gnathopod 1, coxa, anterior and posterior margins straight; propodus, palm with 2 defining spines. Gnathopod 2 hardly larger than gnathopod 1; coxa, ventral and posterior margins straight; basis, lateral flange with only 2 distal setae; carpus, anterior margin not setose, posterior lobe setose; propodus similar in shape to but slenderer than propodus of gnathopod 1; dactyl similar in shape to that of gnathopod 1. Pereiopod 6, basis not posterodistally lobate. Other features as in male.

CONDITION. Brooding young; without pereiopods 5.

VARIATION. Length: male up to 2.0 mm, female up to 2.1 mm. In earliest recognizable males the coxa of gnathopod 1 is not ventrally indented, the basis, propodus, and dactyl are shorter than in older males, the propodus lacks obvious teeth, the palm is marked by two spines with the medial the larger and both being larger than in older males, and the dactyl is evenly curved and without long setae. In late instar males the coxa is bilobate, the thumb is more pronounced (as in *Jassa*), and the defining spines are absent. Such a condition is figured by J. L. Barnard (1970) and is also seen in the underlying new cuticle of the male 4 in Figure 7. Other variation that may occur in either sex is: antenna 1, flagellum with 4–5 articles. Uropod 3, peduncle with 1–2 mid-dorsal spines, outer ramus with 3–4 cusps. In early instar females the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material Examined.—Holotype, male, Waikiki, Oahu, in ocean seaward of aquarium, from *Ulva*, 11 March 1964, J. L. Barnard, collector (BPBM: catalogue no. 7288).

Other Material Examined.—(3 males, 9 females, 7 unsexable juveniles) HAWAIIAN ISLANDS: 1 male, 6 females, 6 unsexable juveniles, Waikiki, Oahu, March, April (BPBM: station no. Fee #1; USNM); 2 males, 3 females, 1 unsexable juvenile, Kaneohe Bay, Oahu, April (BPBM: station no. JLB Hawaii 13). Females ovigerous March, April.

Remarks.—By comparison with *N. claustris* and *N. chinipa, N. lilipuna* is distinctive in many features: in both sexes, by the strong spines on the propodus of pereiopods 3 and 4 and by the single, rather than double comb on the dactyl of gnathopod 1 (and 2 in the female) and pereiopods 5–7, accompanied by a cusp on the posterior margin. There are other, less obvious differences in the more slender pereiopods 5–7, more finely spined maxilliped outer plate, and less spiny uropods.

The male is distinctive in gnathopod structure. In *N. claustris* and *N. chinipa* the basis is longer and broadly flanged, the propodus lacks a thumb, the defining spine is single and much larger in the earlier instar male but is lost later, the hinge teeth become bifid, the palm is more setose, and the dactyl lacks the long setae of *N. lilipuna* and bears two protuberances instead of one.

Neoischyrocerus lilipuna is not a member of the genus *Jassa* because the female's second gnathopod is not enlarged, the thumb on the male's second gnathopod does not originate distally of the palmar defining spines, and the outer ramus of the third uropod lacks the characteristic pair of cusps and basally immersed, dorsally recurved spine. Therefore the genus *Jassa* is unknown in Hawaiian waters.

Jassa socia Myers, 1989a, which occurs in the Cook Islands, the Society Islands, and Papua New Guinea (Myers, 1989a, 1990; pers. comm.), closely resembles *N. lilipuna* in sexually dimorphic traits but differs from this and other members of *Neoischyrocerus* in the following generic level characters: coxae 2–4 shal-

lower than the body; gnathopod 1 (both sexes), gnathopod 2 (female), and pereiopods 5–7 (both sexes), dactyl not facially serrated; female gnathopod 2, palm of the propodus shallowly concave; brood plate setae simple; pereiopods 3 and 4, propodus not spinose. Most of these character states are possessed by members of *Ischyrocerus*. Accordingly, *Jassa socia* is herein transferred to the genus *Ischyrocerus*. *Ischyrocerus* is widespread in both hemispheres and may warrant subdivision upon revision. At that time the genus *Neoischyrocerus* may be enlarged or another genus established for the tropical members of *Ischyrocerus*.

Distribution.—Oahu, Hawaiian Islands, in *Ulva lactuca, Sargassum,* other algae, and small corals at 3–4 m depth, high salinity.

Neoischyrocerus claustris (J. L. Barnard), new combination
Figures 11, 12

Microjassa claustris J. L. Barnard, 1969a, 160–163, figs. 40, 41.
Ischyrocerus claustris: J. L. Barnard and G. S. Karaman, 1991, 201.

Diagnosis.—Gnathopods and pereiopods 5–7, dactyl with double comb of striae. Pereiopods 3 and 4, ventral margins of coxae not excavate; spines on posterior margin of propodus slender and seta-like. Male gnathopod 2, propodus without thumb, palm defined by change of angle, with one large palmar defining spine which is absent in large males; dactyl maximally little more than half length of palm, inner margin with two protuberances proximally and minute setae only.

Description.—ADULT MALE. (Redescription of holotype.) Length 1.9 mm. Gnathopod 1, coxa rectangular, anterior margin distally produced. Coxa 1 : coxa 2, L = 0.71. Coxa 2 : coxa 3, L = 0.96. Gnathopod 1 : gnathopod 2, L = 0.26. Gnathopod 2, coxa, ventral margin straight, posterior margin convex; basis, lateral flange, anterior margin with row of minute setae which grade into spines distally; ischium with spines; carpus, anterior margin with 1 mid-distal and 1 distal spine, posterior lobe setose; propodus, palm moderately setose, with 2 sequential protuberances adjacent to origin of dactyl and change of angle proximally to define palm, but without tooth or spine; dactyl : propodus, L = 0.67, inner margin with 2 protuberances proximally, setae minute. Pereiopods 3 and 4 lacking, coxae, ventral margins straight. Pereiopod 5, coxa, posterior lobe not produced ventrally. Epimera 1–3, posterodistal margin with notch and minute seta. Uropods 1 and 2, peduncle with mid-dorsal spines. Uropod 3, peduncle with 5 mid-dorsal and 1 distal spine; outer ramus with 3 terminal cusps and apical seta.

CONDITION. Without antennae or pereiopods 3–7.

ADULT FEMALE. Paratype. Length 1.5 mm. Without antennae. Gnathopod 1, coxa, anterior slightly convex, posterior margin straight; propodus, palm with 2 defining spines. Gnathopod 2 hardly larger than gnathopod 1; coxa, ventral margin convex, posterior margin shallowly concave; basis, lateral flange with 3 setae; carpus anterodistally setose, posterior lobe setose; propodus similar in shape to but slenderer than propodus of gnathopod 1; dactyl similar in shape to that of gnathopod 1. Pereiopods 3 and 4, propodus, posterior marginal spines slender, seta-like. Pereiopod 6, basis posterodistally lobate. Uropod 3, peduncle with 2 spines mid-dorsally and 1 distally. Other features as in male.

CONDITION. Brooding young; without antennae.

VARIATION. Length: male up to 1.9 mm, female up to 2.2 mm. Earliest recognizable males differ from older males in the appearance of the second gnathopod. In young males the basis, propodus, and dactyl are short, the palm of the propodus is defined by a large spine, and the dactyl lacks protuberances. Either sex may

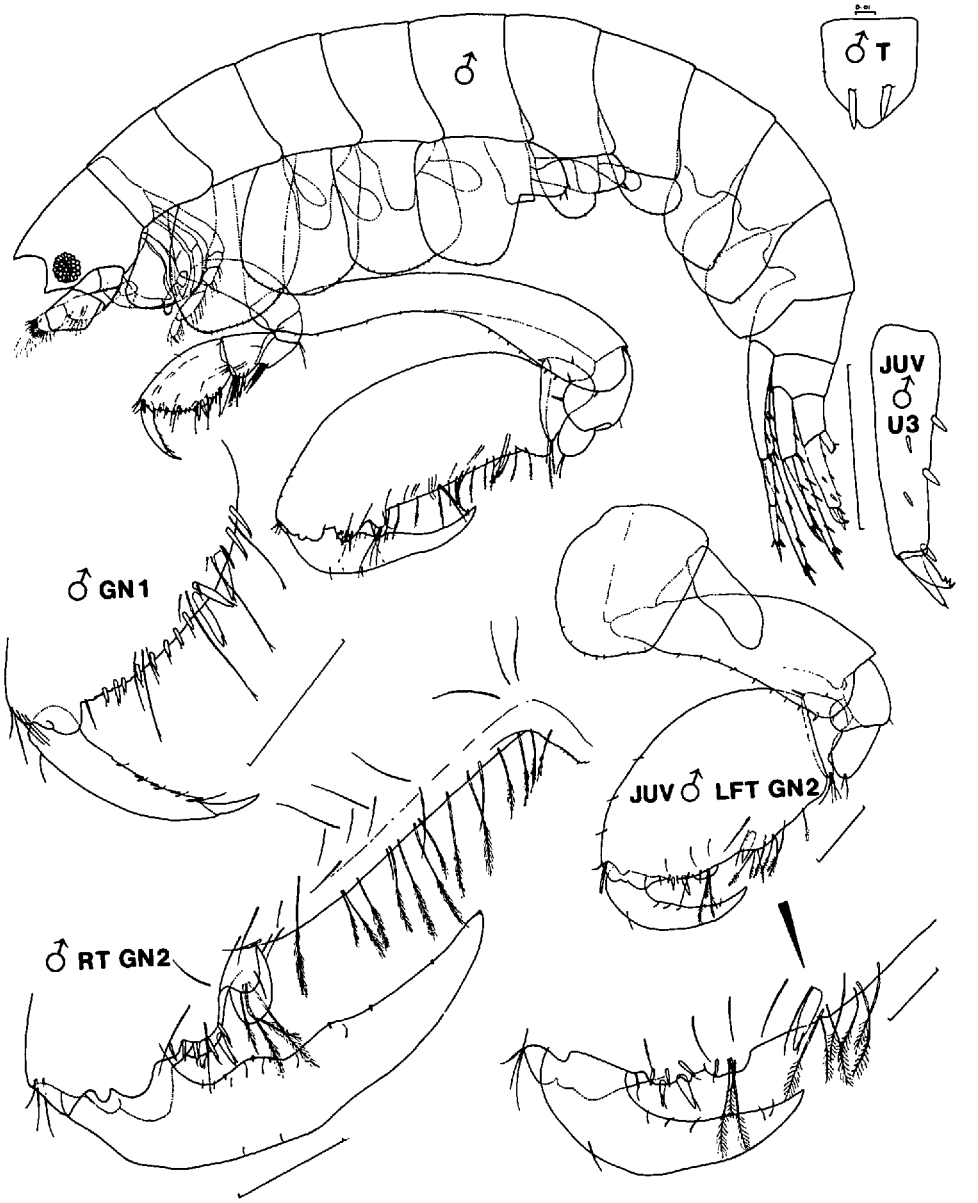


Figure 11. *Neoischyrocerus claustris* (J. L. Barnard). Male, holotype, 1.9 mm; juvenile male, paratype, 1.8 mm; La Jolla, California, 11–13 November 1962. Lateral views: whole body, uropod 3, and full juvenile male left gnathopod 2; dorsal view: telson; other views medial. Appendages of the holotype unless indicated otherwise. Scale 0.1 mm.

vary as follows: antenna 1, flagellum with 4–5 articles. Uropod 3, peduncle with 2–5 spines mid-dorsally. In early instar females the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material Examined.—Holotype, male, paratypes, 3 males, 21 females, 1 unsexable juvenile, La Jolla, California, from scraping of calcareous sponge under ledge in surge channel, 11–13 November 1962, J. L. Barnard, collector (AHF(NHMLAC): catalogue no. 624, station no. 45-W-5).

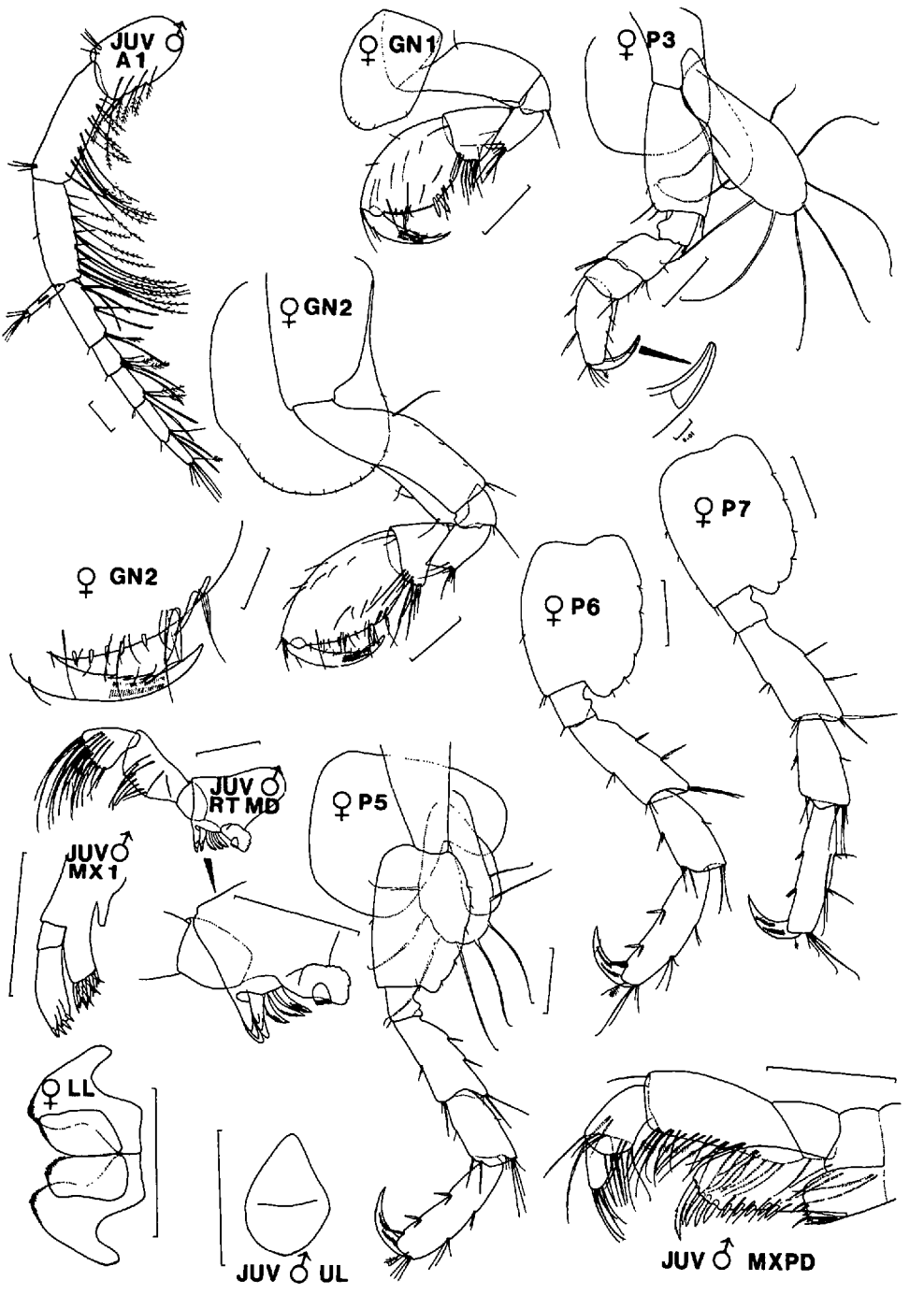


Figure 12. *Neoischyrocerus claustris* (J. L. Barnard). Adult female, paratype, 1.5 mm; juvenile male, 1.8 mm; La Jolla, California. 11–13 November 1962. All views medial. Scale 0.1 mm unless indicated otherwise.

Other Material Examined.—(2 males, 1 female) CALIFORNIA: 2 males, 1 female, La Jolla, Corona del Mar, November, December, J. L. Barnard, collector (AHF(NHMLAC): station nos. 45-W-1; 46-G-4). Females ovigerous November.

Remarks.—*Neoischyrocerus claustris* closely resembles *N. chinipa* but differs in the following respects: pereiopods 3 and 4, coxae not broadened ventrally or indented; pereiopod 5, coxa, posterior lobe not downturned; male gnathopod 2, dactyl not more than two thirds the length of the palm of the propodus. A number of species of *Ischyrocerus* resemble *N. claustris* in the appearance of the male's second gnathopod but differ in other respects: *I. commensalis* Chevreux, 1900, third uropod outer ramus having at least 6 cusps and a terminal, basally immersed spine, female gnathopod 2, propodus enlarged, palm shallowly concave; *I. carinatus* K. H. Barnard, 1916, male gnathopod 2 about 6 times the length of gnathopod 1, basis of gnathopod 1 expanded; *Ischyrocerus* spp. A and B of J. L. Barnard (1969a), uropod 3 outer ramus with more than 3 cusps and having a terminal, basally immersed spine, female gnathopod 1, propodus much narrower; *I. oahu,* uropod 3 outer ramus having more than 3 cusps, the gnathopod 1 having a longer carpus and wider propodus, and the male gnathopod 2 propodus lacking a proximal palmar protuberance, the dactyl being longer, and the palm being more transverse in the juvenile; *I. o. armatus,* uropod 3 outer ramus having more than 3 cusps and the male gnathopod 2 having 2 large palmar defining spines on the propodus; *I. longimanus* (Haswell, 1879), uropod 3 outer ramus having more than 3 cusps, and the propodus of the male gnathopod 1 and the female gnathopods 1 and 2 being much slenderer.

Distribution.—Confirmed: Corona del Mar and La Jolla, California, from sponges on ledges of surge channels, low intertidal zone, high salinity exposed rocky coasts.

Unconfirmed (in the literature): Cayucos, in sponges, *Egregia* and *Macrocystis* stipes and holdfasts, *Amaroucium,* coralline algae, short-tufted red algae, loose rocks, tunicates, *Phyllospadix,* calcareous and soft polychaete tubes, and under rocks, low intertidal to 8 m depth, high salinity exposed rocky coasts (collection records in J. L. Barnard, 1969a).

Neoischyrocerus chinipa (J. L. Barnard), new combination
Figure 13

Microjassa chinipa J. L. Barnard, 1979, 127–129, figs. 68, 69.
Ischyrocerus chinipa: J. L. Barnard and G. S. Karaman, 1991, 201.

Diagnosis.—Gnathopods and pereiopods 5–7, dactyl with double comb of striae. Pereiopods 3 and 4, ventral margins of coxae shallowly excavate; spines on posterior margin of propodus slender and seta-like. Adult male gnathopod 2, propodus without thumb, palm defined by change of angle, with one large palmar defining spine which is absent in large males; dactyl maximally full length of palm, inner margin with two protuberances proximally and minute setae only.

Description.—ADULT MALE. (Description of paratype.) Length 2.1 mm. Gnathopod 1, coxa rectangular, anterior margin not distally produced. Coxa 1 : coxa 2, L = 0.75. Coxa 2 : coxa 3, L = 1.16. Gnathopod 1 : gnathopod 2, L = 0.40. Gnathopod 2, coxa, ventral margin shallowly concave, posterior margin straight; basis, lateral flange, anterior margin with row of minute setae which grade into spines distally; ischium with spines; carpus, anterior margin with 1 distal spine, posterior lobe setose; propodus, palm moderately setose, with 2 sequential protuberances adjacent to origin of dactyl and change of angle proximally to define

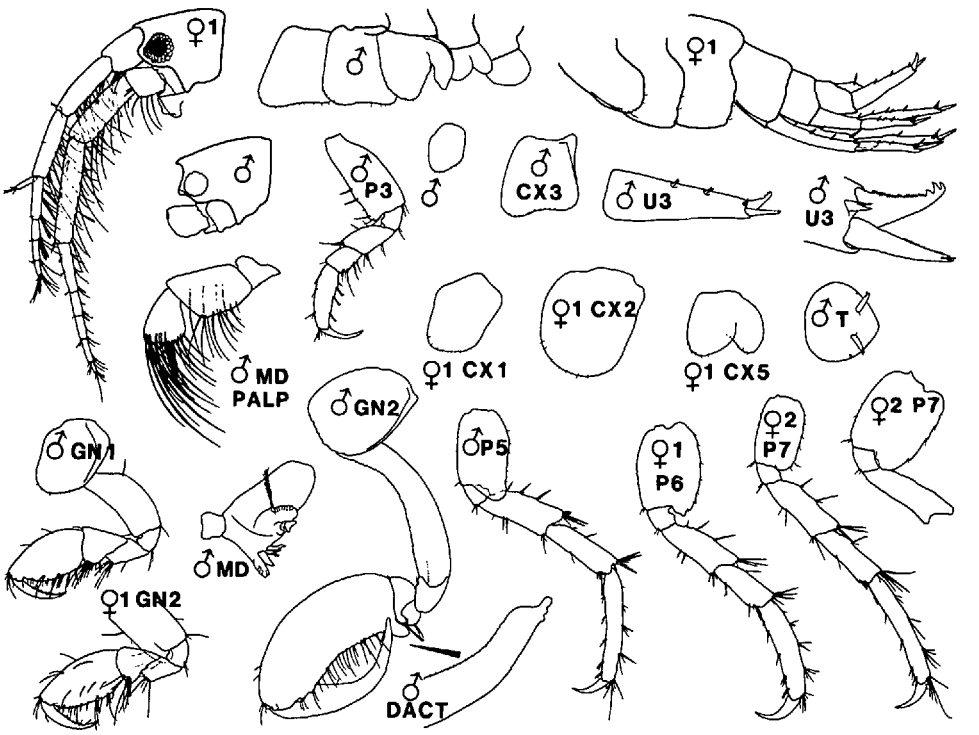


Figure 13. *Neoischyrocerus chinipa* (J. L. Barnard). Holotype, male, 2.58 mm; adult female 1, 2.11 mm; DAW 26, wash of intertidal rocks covered with short "*Ulva*," Isla Santa Cruz, Galapagos Islands, no date. Adult female 2, 2.08 mm; DAW 40, wash of intertidal rocks, Academy Bay, Isla Santa Cruz, Galapagos Islands, 16 February 1962. Modified from J. L. Barnard (1979).

palm, but without tooth or spine; dactyl : propodus, L = 0.73, inner margin with 2 protuberances proximally, setae minute. Pereiopods 3 and 4 lacking, coxae, ventral margins shallowly concave. Pereiopod 5, coxa, posterior lobe produced ventrally. Epimera 1–3, posterodistal margin with notch and minute seta. Uropods 1 and 2, peduncle with mid-dorsal spines. Uropod 3, peduncle with 4 mid-dorsal and 1 distal spine; outer ramus with 3 terminal cusps and apical seta.

CONDITION. Without right antenna 1, left antenna 2, right gnathopod 1, and pereiopods 3–7.

ADULT FEMALE. Female "w" of J. L. Barnard (1979). Length 2.1 mm. Antenna 2 as setose as antenna 1. Gnathopod 1, coxa, anterior margin straight, posterior margin shallowly concave; propodus, palm with 2 defining spines. Gnathopod 2 hardly larger than gnathopod 1; coxa, ventral margin convex, posterior margin straight; basis, lateral flange with moderately long setae; carpus not anterodistally setose, posterior lobe setose; propodus similar in shape to but slenderer than propodus of gnathopod 1; dactyl similar in shape to that of gnathopod 1. Basis not posterodistally lobate in pereiopod 5, but lobate in pereiopod 6. Uropod 3 unknown. Other features as in male.

CONDITION. Unknown.

VARIATION. Length: male up to 2.6 mm, female up to 2.1 mm. The number of palmar defining spines on the gnathopod 1 may be 2 or 3. In small males, the basis, propodus, and dactyl are shorter than in large males, the palm of the propodus is defined by a large spine, and the dactyl lacks protuberances. In small

males and females the ventral margins of coxae 3 and 4 are straight, rather than concave as in large males. The posterior lobe of coxa 5 extends ventrally in small males but is not extended in females. The female coxa 1 is deeper relative to coxa 2 than in the male. In addition, the basis of pereiopod 5 is not posterodistally lobed in the female as it is in the male. The number of apical cusps on the outer ramus of uropod 3 varies from 3 to 4. In early instar females, the pereiopod 2–5 brood plates lack setae or are absent entirely.

Type Material Examined.—Paratypes, 10 males, 21 females, 7 unsexable juveniles, Academy Bay, Isla Santa Cruz, Galapagos Islands, 1962, intertidal, rock wash; J. L. Barnard, collector (USNM: station no. DAW 26).

Other Material Examined.—(51 males, 111 females, 59 unsexable juveniles) GALAPAGOS ISLANDS: 34 males, 99 females, 58 unsexable juveniles, Isla Santa Cruz and Tower Island, January and February 1962 and 1964, amongst algae and coral, J. L. Barnard and E. Y. Dawson, collectors (USNM: station nos. GAL 114, 115, 116, DAW 3, 4, 9, 19, 23, 27, 31, 35, and 40). PANAMA: 17 males, 12 females, 1 unsexable juvenile, Pacific side of Canal zone, Diablo Swimming Club, wharf, wash of sponges and fouling matter from inner brackish tub, 17 April 1955, J. L. Barnard, collector (USNM: station no. PAN 14). Females ovigerous January, February, and April.

Remarks.—The holotype was not available for study. However it is refigured from J. L. Barnard (1979) in Figure 13. See also remarks for *Neoischyrocerus claustris.*

Distribution.—Galapagos Islands and Pacific coast of Panama, intertidal to 9 m depth, sponges, algae, rocks, and corals, high salinity.

Discussion

Nothing is known about the behavior of any species of *Microjassa* or *Neoischyrocerus.* As for most Corophioidea all species bear spinning glands and pore-tipped dacytls on pereiopods 3 and 4, indicating that they are tube dwellers. The tube building habit offers protection and provides a centre for the accumulation of sediment and detritus which are incorporated into the tube matrix and are probably used as food (Skutch, 1926; Enequist, 1950). Presumed adaptations for tube living are the cusped third uropods for grasping the tube and the dorsally erect telson setae to sense body position relative to the tube wall. It can be supposed that the characteristic shallowness of coxae 1 and 5 and the posterior excavation of coxa 4 in all members of *Microjassa* is an adaptation to accommodate the deep coxae 2–4, the shallow anterior and posterior coxae enabling the body to bend. The antennae of *Microjassa* and *Neoischyrocerus* have similar setation and spination to species of the genus *Jassa,* suggesting that feeding habits are similar (suspension and deposit feeding). As in other Corophioidea the greatest morphological variation occurs in the sexually dimorphic second gnathopods, indicating that the males are mate guarders (see Conlan, 1991).

The name *Microjassa* was coined by Stebbing (1899) for the type species, *M. cumbrensis,* and was based, no doubt, on the superficial resemblance of the species to members of the genus *Jassa* (Conlan, 1989). *Neoischyrocerus lilipuna* was initially placed in the genus *Jassa* for the same reason. This convergent similarity is the prominent thumb that develops on the propodus of the second gnathopod of some, but not all males of the genus (thumbing occurs in *M. floridensis, M. macrocoxa, M. tetradonta, M. boreopacifica, M. cumbrensis,* and *N. lilipuna*). Unlike *Jassa,* however, thumbing is not a synapomorphy for either genus and development of the thumb is different. In *Microjassa* and *Neoischyrocerus* the thumb develops at the origin of the palmar defining spines, so that remnants of these spines may remain at the tip (Figs. 1–3, 5, 6, and 10). In *Jassa,* however, the thumb develops distal of the palmar spines (Conlan, 1990). Furthermore, in

Jassa the development of the thumb is delayed to the last molt (Conlan, 1989), while in *Microjassa* and *Neoischyrocerus* there is no such evidence for a delay. Male second gnathopod enlargement and thumb production serves as a signalling device to indicate sexual mating intent to females and dominance over non-thumbed males in *Jassa marmorata* Holmes, 1903 (Borowsky, 1983, 1985) and may have a similar function in *Microjassa*. The lack of delay in thumb development in *Microjassa* and *Neoischyrocerus* suggests that they do not live in such high density situations as *Jassa* where competition and strong bias of the operational sex ratio toward males would drive selection for delay of sexual activity. It would be of interest to compare mating behaviors of thumb-producing and thumbless species of *Microjassa,* most possible in the northeastern Pacific, where the ranges of the two types overlap.

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